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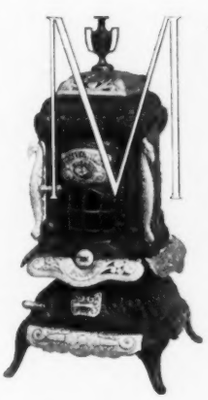
THE FOUNDRY

Vol. 34, No. 2 CLEVELAND, OHIO, APRIL, 1909 Whole No. 200

HINGED MATCH PLATES FOR STOVE WORK

New roll-up process for molding stove plates which permits of returning the pattern to the mold---Casting aluminum match plates and other novel stove foundry methods



MATCH PLATES, match boards and other match-making devices rank among the pioneer, semi-mechanical, foundry molding appliances, and as they effect great economies in molding cost, are in widespread use today. As in other lines of foundry practice, improvements in these processes have been marked in recent years, and the match board with its removable patterns, as well as the follow-board which is in the same class, has been followed by the match plate with the two halves of the pattern on opposite sides of the plate. The hinged plate arranged between the cope and drag halves of the flask, devised to facilitate the rolling out of the patterns, is by no means a recent innovation and has been used extensively, especially on shallow work. In many plants, however, it has been discarded owing to the difficulties involved in keeping the hinges in alignment, and the iron and brass match plates used were easily broken or bent, while their weight made them exceedingly difficult to handle. In most stove foundries follow-boards ars used extensively, although hinged match plates would be adopted provided the difficulties outlined could be overcome. This was one of the numerous problems which confronted the Buck's Stove & Range Co., St. Louis, when it was decided to adopt mechanical molding appliances, and while numerous molding machines were installed, nevertheless, it was found that many patterns could be mounted to advantage on hinged match plates. Owing to the weight of iron and brass match plates, it was concluded that a lighter metal should be adopted, and furthermore, owing to the large number of patterns mounted on follow-boards in use in this plant, it was believed that a simple method could be devised for making these plates. An aluminum alloy was adopted contain-

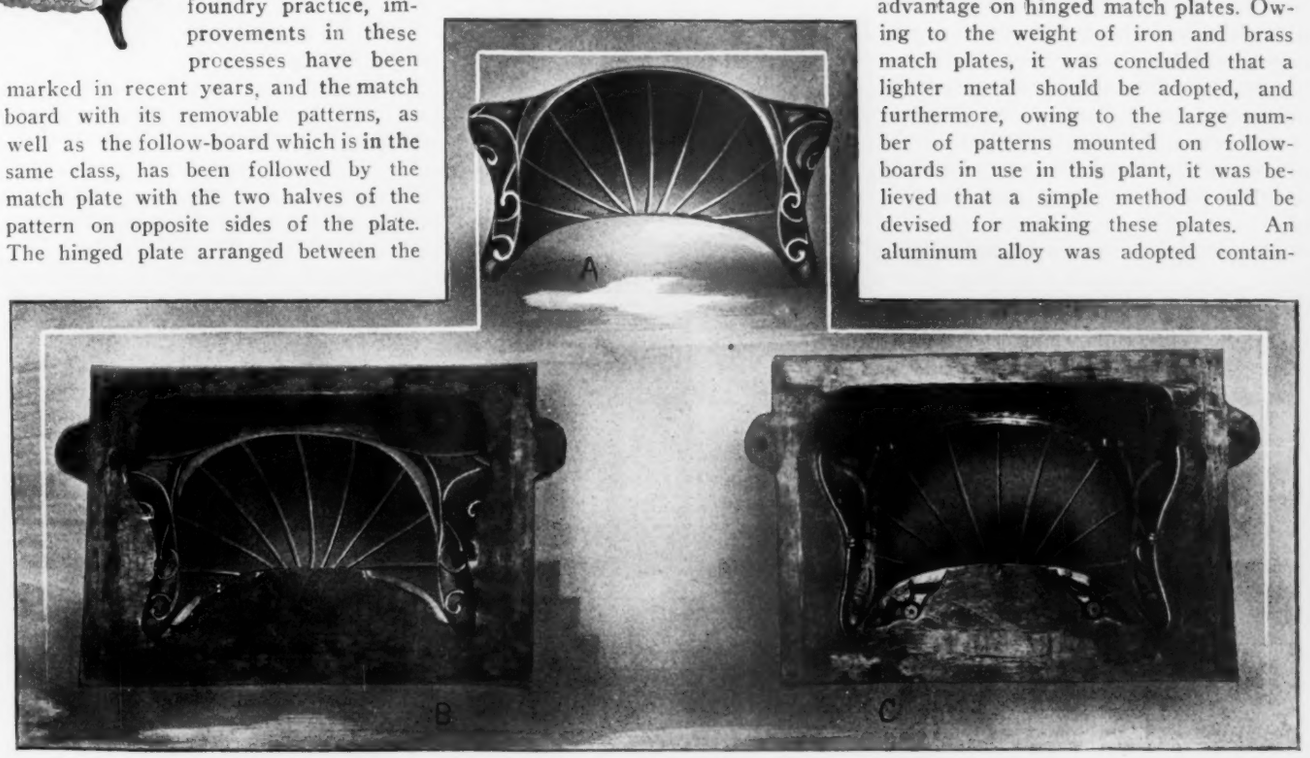


FIG. 1—DRAG AND COPE SIDES OF BASE BURNER DOME FRONT, ALUMINUM MATCH PLATE. THE CASTING IS SHOWN AT A

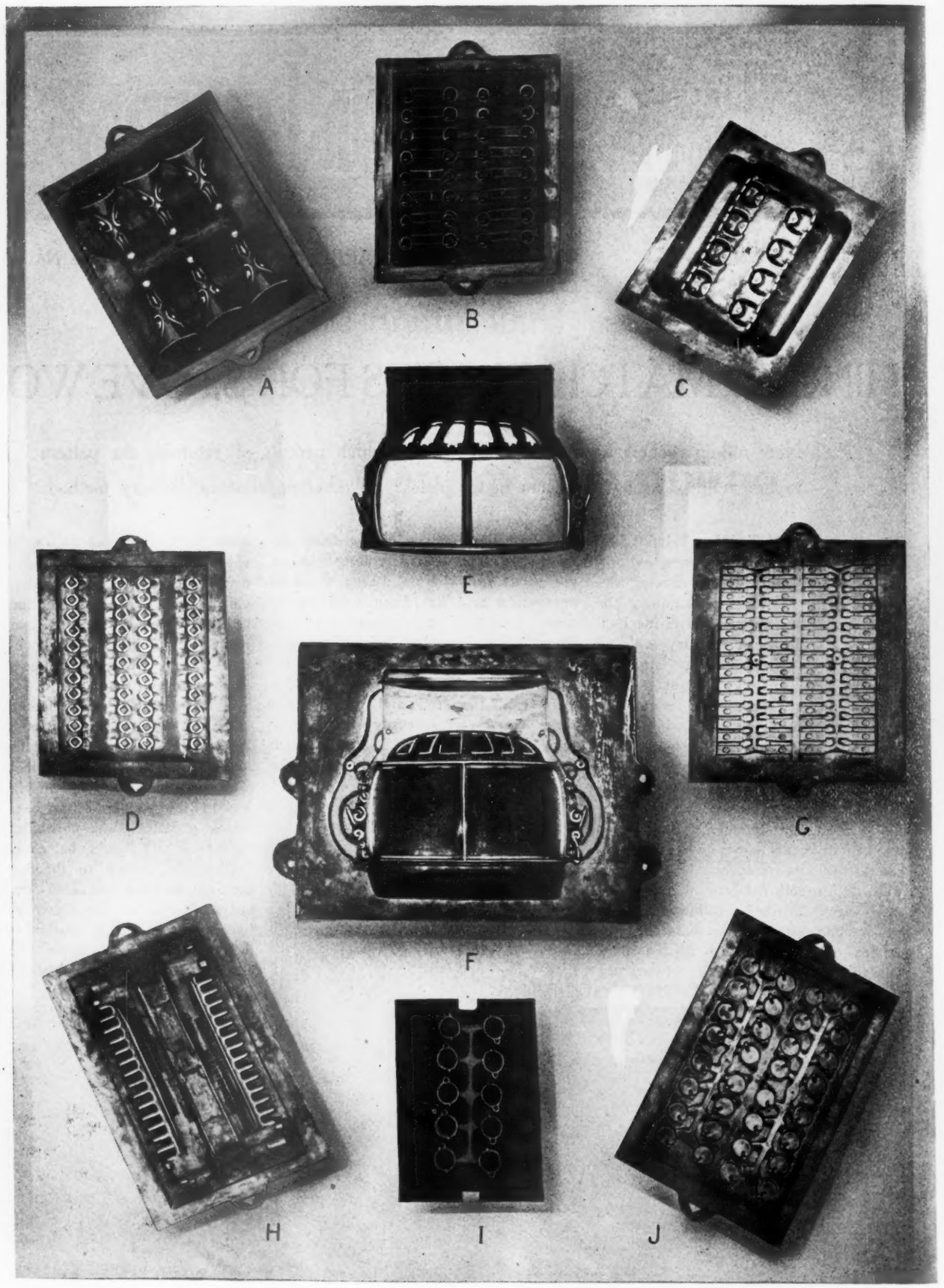


FIG. 2—ALUMINUM MATCH PLATES FOR STOVE PLATE WORK. CARDED PATTERNS ARE SHOWN AT A, B, C, D, G AND J

ing zinc 1, and aluminum 2, and these plates withstand severe foundry usage without being broken or bent.

Aluminum Match Plate Process.

Numerous methods of making match plates were tried and finally a process was developed that can be mastered by a molder in a few hours. In Figs. 3 and 4 are shown two views of the drag of a match plate mold. The patterns of the two gas stove centers are shown in the sand in Fig. 3, and in Fig. 4, they have been withdrawn from the mold. Before making the mold, a flask is selected somewhat larger than the extreme dimensions of the plate and the white metal patterns are rammed up in the sand in the usual way. After the cope has been finished it is lifted off, set aside, and wooden strips are nailed on the drag flask as show in Fig. 3. A wooden frame, the size of the aluminum plate desired, with ears at either end for the flask pin holes, is laid on the drag and sand is filled in between the frame and the ¼-inch strips on the drag flask. After the sand has been leveled off smooth with the frame and the wooden strips, the frame is drawn out of the sand and an impression is left in the drag half of the mold ¼-inch deep which is the thickness of the pattern plate. After the pattern has been drawn, the cope is placed on the drag, the ¼-inch strips remaining in position. The mold is then clamped, the metal is poured and the match plate, after being shaken out, is taken to the pattern shop where the pin holes are drilled, and if it is to be a hinged plate, the hinges are fitted. Owing to the high shrinkage of the metal used and to get it into the mold as speedily as possible, the aluminum alloy is poured simultaneously from four generous sprues and a large riser is usually placed in the center of the mold.

In the pattern shop the plate is filed and scraped to a smooth surface, and after being finished, is taken to the foundry where a trial casting is made. This is done for the purpose of detecting imperfections in the plate which is again returned to the pattern shop for the final finishing. One of these trial castings, a cook stove hearth, is shown in Fig. 17. At various points large fins are shown, while several of the bolt holes are likewise closed with small fins. This casting shows the patternmaker where the imperfections in the plate are located and these are remedied to reduce the cleaning and fitting expense to the minimum on the subsequent castings made in the foundry.

A suitable hinge which would constantly remain in alignment and permit the printing-back of patterns if necessary, was the next problem to be solved. After many trials, a hinge was designed which meets all requirements and those that have been in use for more than a year show practically no wear, while in addition the match plates to which they are fitted can be printed back as frequently as desired without injury to the mold. The assembled hinge, together with its three sections, is illustrated in Fig. 18, and in Fig. 24, sectional views of a flask with the hinge attached are shown. In Fig. 18 and at A, Fig. 24, is shown the hinge member which is fastened to the cope flask. The section of the hinge attached to the drag is shown at B, and C is the hinge member attached to the match plate. Sections A and B are made of cast iron, while C is a nickel bronze casting, which is made of this material to resist severe wear. The hinge members are so constructed that the cope can be swung upwardly and removed if desired, and the match plate can thereafter be rolled-up and lifted out of the hinge member on the drag. After the match plate has been removed the hinge section on the cope is inserted in the co-operating hinge member on the drag and the mold is closed.

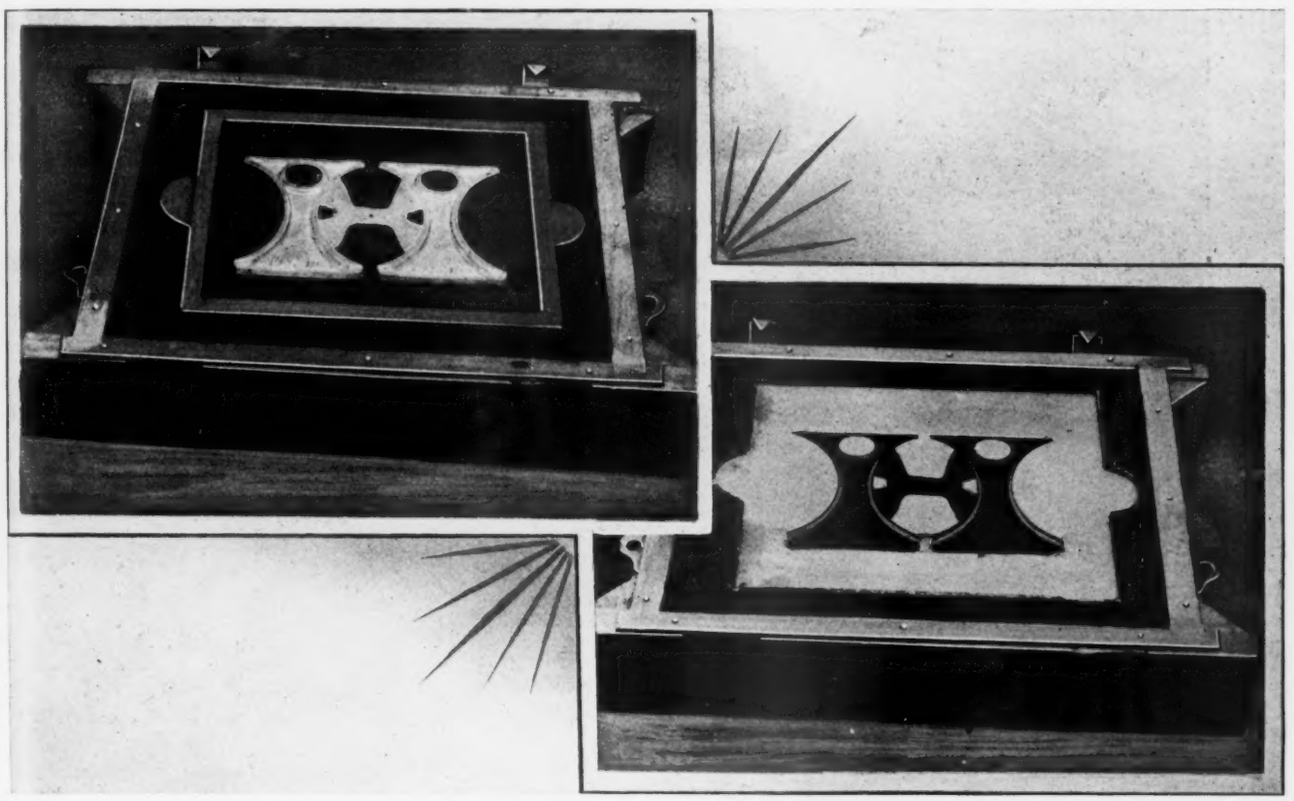


FIG. 3—DRAG HALF OF MOLD FOR ALUMINUM MATCH PLATE, SHOWING ¼-INCH STRIPS ON THE FLASK AND WOOD FRAME AND PATTERNS IN THE SAND

FIG. 4—PATTERNS AND WOOD FRAME DRAWN OUT OF THE SAND. IMPRESSION IN THE SAND FOR ALUMINUM MATCH PLATE, ¼-INCH DEEP

The drag hinge section is provided with a web from which semi-circular flanges project laterally on opposite sides. The web is provided with a slot that forms a socket for a portion of the cope hinge section, and the faces of the web are recessed to form bearings for conical portions of the cope hinge member. The match plate hinge section is provided with two semi-circular flanges that rest upon the inside faces of the flanges on the drag hinge section when the match plate is in position between the cope and drag halves of the flask. The flanges on the match plate hinge section are spaced apart so as to provide a slot into which the hinge section of the drag projects, and these flanges are provided on their outer edges with strengthening webs to form a socket for receiving the hinge member on the cope.

Cope Hinge Section.

The cope hinge section is provided with conical projections whose apexes are connected together as shown at A, Fig. 24, to produce a fulcrum pin, having a contracted central portion which fits into the slot formed in the web of the drag hinge section.

Before ramming a mold the match plate is arranged between the cope and drag as shown in the sectional view D, Fig. 24. After the cope and drag have been rammed, the cope is rolled back and is supported, while the match plate is being rolled-up and out of the drag half of the mold. As the match plate is rolled up its flanges turn on the inside faces of the semi-circular flanges of the drag hinge section, thus causing it to move evenly, and no skill is required by the operator to lift the match plate out of the mold. After the match plate has been raised a sufficient distance to withdraw the pattern on the drag side from the sand, the match plate is lifted from the mold. The drag hinge section is so constructed that the hinge member on the match plate passes out of engagement with the same when the match plate is lifted out of the sand.

At F, Fig. 24, the match plate has been removed from the flask and the cope and drag hinge sections are shown in the positions they assume when the mold is closed. A flask with two sets of hinges attached, with the match plate between the cope and drag, is shown at G, Fig. 24. When attached to the flask, one set of hinges is given sufficient play to provide for the contraction and expansion of the cope and drag halves of the flask. Shop rights for the use of this hinge and roll-up process controlled by the Buck's Stove & Range Co. are sold exclusively by the Arcade Mfg. Co., Freeport, Ill.

Use of Hinged Match Plates.

The method of making a mold by this roll-up process is clearly shown in Figs. 5 and 7. The aluminum match plate, Fig. 6, contains the cope and drag patterns of a steel range, pouch-end, on its opposite sides, the drag being shown in this illustration. The two hinges on the plate can also be clearly seen. After the match plate has been adjusted between the cope and drag halves of the flask, the drag is rammed, the mold rolled over and the cope is made. It is then swung back and supported, as shown in Fig. 5, which also shows the match plate in the drag. The match plate is then rolled up as illustrated in Fig. 7, lifted out the cope is lowered and the mold is closed and clamped. Before lifting out the match plate, the drag pattern can be printed-back if desired, and in this case the pattern was returned to the drag, Fig. 7, a number of times without

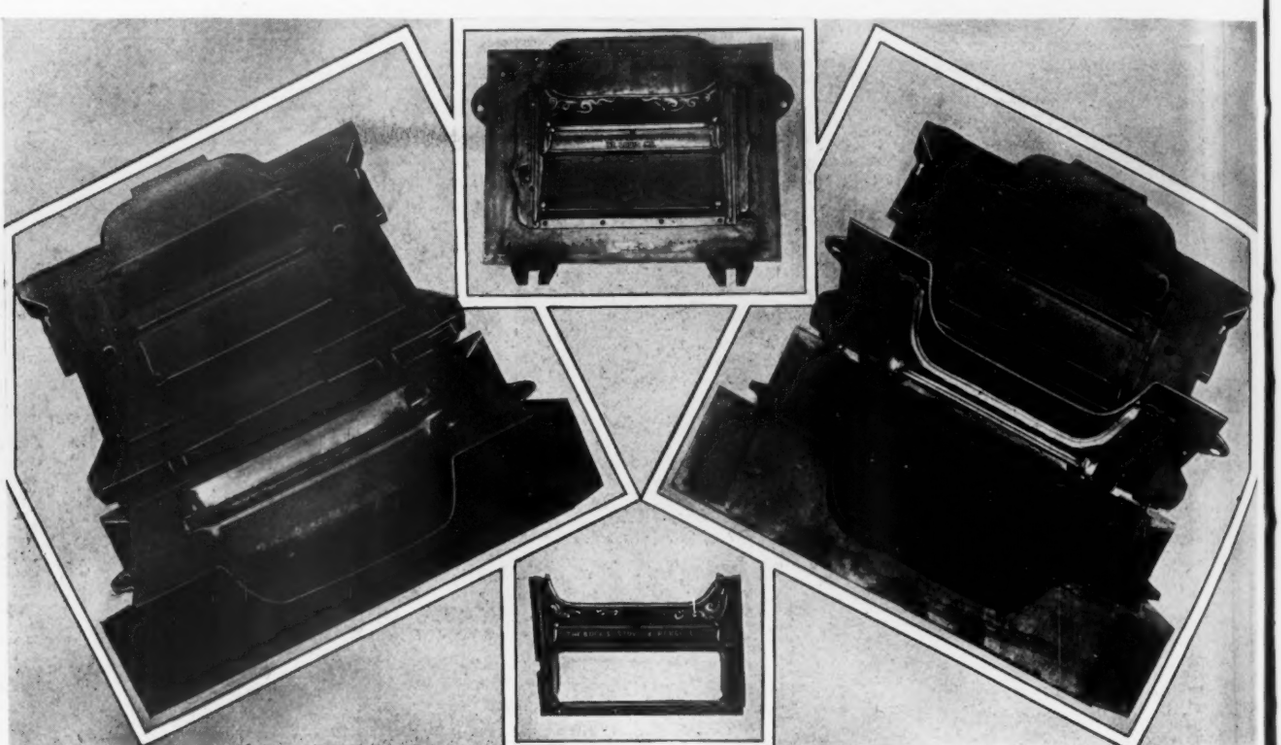


FIG. 6—DRAG SIDE OF STEEL RANGE POUCH-END, HINGED ALUMINUM MATCH PLATE

FIG. 5—MOLD OF STEEL RANGE POUCH-END, MADE WITH THE HINGED MATCH PLATE SHOWN IN THE DRAG HALF OF THE MOLD

FIG. 7—HINGED ALUMINUM MATCH PLATE RAISED AWAY FROM THE DRAG HALF OF THE MOLD

FIG. 8—STEEL RANGE POUCH-END CASTING

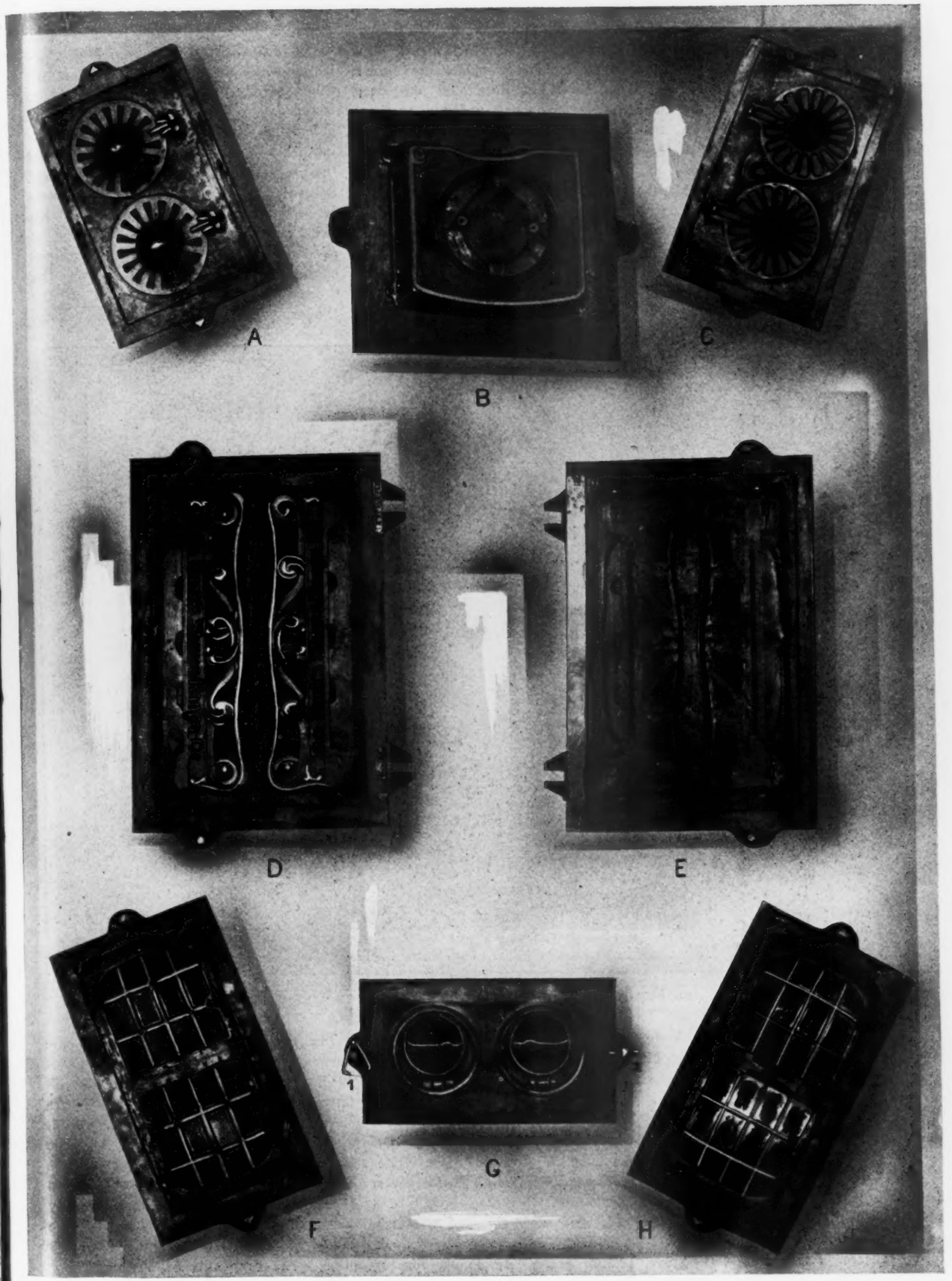


FIG. 9—ALUMINUM MATCH PLATES CONTAINING DIFFICULT STOVE PLATE PATTERNS

injury to the mold. The finished steel range, pouch-end, casting is illustrated in Fig. 8.

Deep and Shallow Work.

Aluminum match plates are now being made of all the patterns mounted on follow-boards at the plant of the Buck's Stove & Range Co. The roll-up process will be used for the bulk of the work and the flasks and match plates will be equipped with roll-up hinges. Fire pots and other deep work can be made by this process as readily as the simpler, shallow sections with great saving in the cost of molding. The pattern shown in Fig. 6 has a 4½-inch draft, while the flask, Figs. 5 and 7, is 19 x 25 inches. All of the castings of the stoves shown in Figs. 11, 12 and 13 were cast in molds made from match plates. A steel range is illustrated in Fig. 11, a cook stove in Fig. 12 and a base burner in Fig. 13.

Match Plates for Stove Work.

Figs. 2 and 9 show a variety of match plates for stove plate work, most of which will be equipped with hinges for the roll-up process. At A, Fig. 2, is shown the drag side of an aluminum match plate containing the patterns of six laundry stove legs; a card of 16, double pipe hole stops, is shown at B; C shows eight center rests on a card, whereas only four were molded to advantage on one card when the patterns were mounted on a follow-board; two cards of base burner door latches on one match plate are shown at D. At F is illustrated the drag side of a base burner, upper door front match plate and the casting is shown at E; two cards of oven door latches, 30 on each card, are shown at G, whereas formerly there were only 20 patterns on a card, one card to the mold; the match plate of two, steel range front grates is illustrated at H, and by the use of match plates these grates are now made two in a mold, while formerly, when mounted on follow-boards only one was made in a mold. The advantage of match plates for carded patterns is graphically shown at I and J. The follow-board, I, contains one card of ten, coil stop patterns, whereas the match plate with two cards contains 32 patterns on a plate, thereby reducing the molding cost about 70 per cent.

The drag and cope sides of a match plate containing two patterns of oak stove, bottom grates are shown respectively at A and C, Fig. 9; at D and E are shown the drag and cope sides of two large hinged match plates, 20 x 30 inches, containing two patterns of steel range, back end shelves. The drag and cope sides of two mica door frames on one match plate are shown at F and H respectively. To facilitate the fitting of these frames, a fitting edge is allowed on the match plate. Another match plate containing two ring covers is shown at G, and the patented punching device for making the openings in the mold for the lugs in the cover lifting socket is shown at 1, while the plugs for covering the sockets in the match plate are shown at 2. This method of punching the openings in these sockets has, however, been superseded by the process described on page 224 of the January, 1909, issue of THE FOUNDRY.

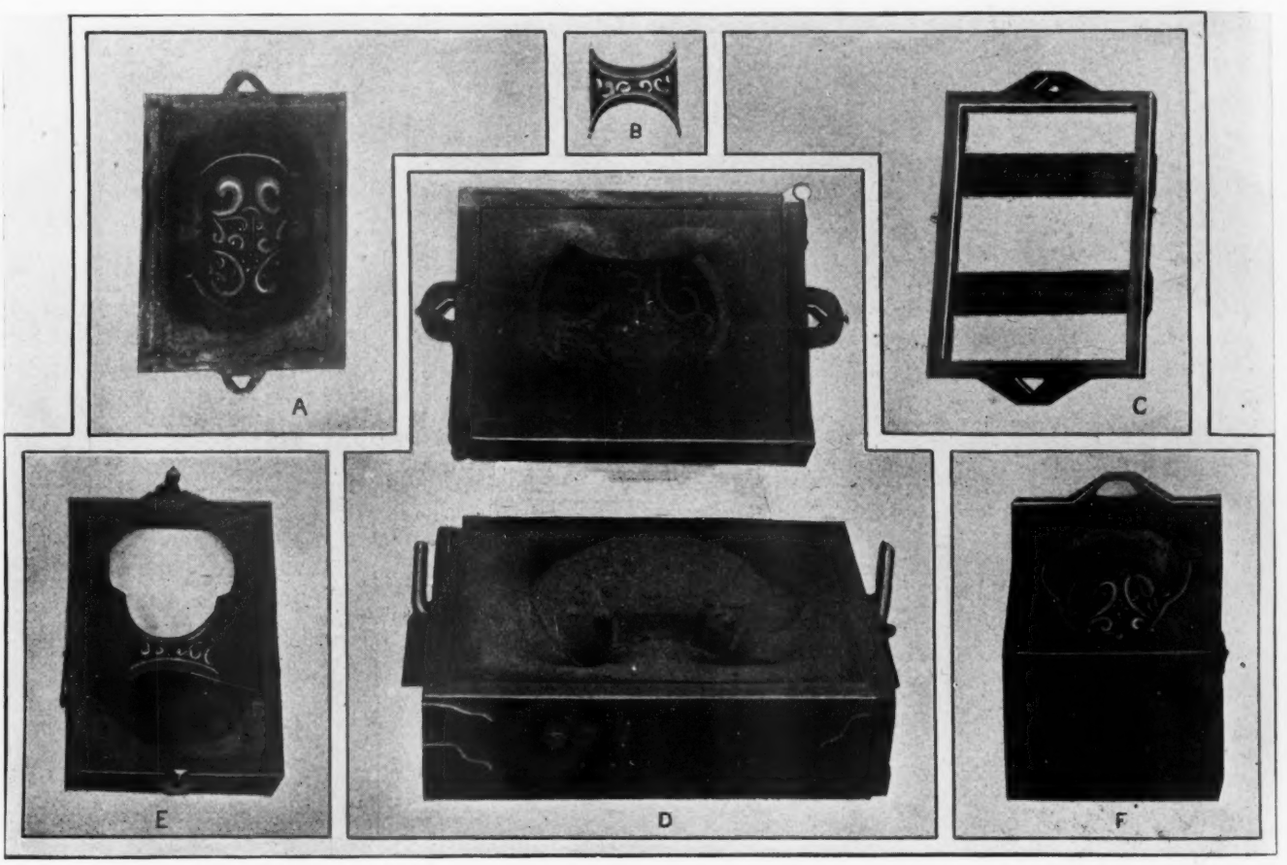


FIG. 10—ALUMINUM MATCH PLATE AND FOLLOW-BOARD FOR MAKING THE MOLD OF A ONE-PIECE, BASE BURNER ELBOW

The drag and cope sides of a base burner, dome front match plate, 26 x 19 inches, which will be provided with hinges for the roll-up process, are shown respectively at B and C, Fig. 1, and the casting is shown at A. The match plate of a small fire pot is shown in Fig. 19, while Fig. 20 shows a cook stove, hearth front, an extremely difficult pattern to draw out of the sand, mounted on a hinged match plate. The drag side of a range, door front match plate is illustrated in Fig. 22 and the casting is shown in Fig. 21.

For cored castings a follow-board match plate, Fig. 15, containing split

brass patterns on opposite sides of the aluminum match plate has been devised. This plate contains two patterns of gas stove burners and the process of making the same is as simple as it is novel. A wooden follow-board for the split patterns is made as perfectly as if it were intended for use in the foundry. The split patterns are removed from the follow-board and the drag is then rammed up on this board which is removed when the mold is made, and the cope is rammed in the drag mold. After the cope has been lifted off, ¼-inch strips are fastened to the parting side of the drag flask, a wooden frame the size of the match plate is laid on the drag and the same method is pursued as previously described in making aluminum match plates. The casting is a two-piece follow-board onto which the split patterns are mounted. To facilitate locating the pattern accurately on the opposite sides of the plate they are carefully drilled while held together. The aluminum follow-board is also drilled, the holes conforming to those in the pattern, and when the patterns are bolted together on the opposite sides of the plate it is impossible to secure any but an accurate fit. The drag and cope sides of an aluminum follow-board before the patterns were mounted are shown in Figs. 14 and 16.

The match plate and follow-board of a one-piece, base burner elbow, as well as the cope and drag of the finishing mold are shown in Fig. 10. Owing to the large, hanging green sand core, and the thin section of the metal, this is an exceedingly difficult casting to mold, but by the use of a combination sand match and aluminum match plate the making of the mold has been reduced to a comparatively simple operation, and only one roll-over is now necessary as compared with three before the use of this device, shown assembled at F. The follow-board is shown at E, the aluminum match plate at A, and B is the loose piece which forms the small arc of the elbow, while C is the frame which supports the aluminum match plate. The core, which is supported at either end as shown at D, is rammed first. The drag is then rammed and the loose piece B is lifted off. The mold is next rolled over and the cope is rammed and the pattern is drawn.

Two simple flask clamps made in one piece, used in the foundry of this concern are shown in Fig. 23. The molder, by pressing the projecting lug on the clamp with his foot firmly adjusts the same on the flask.

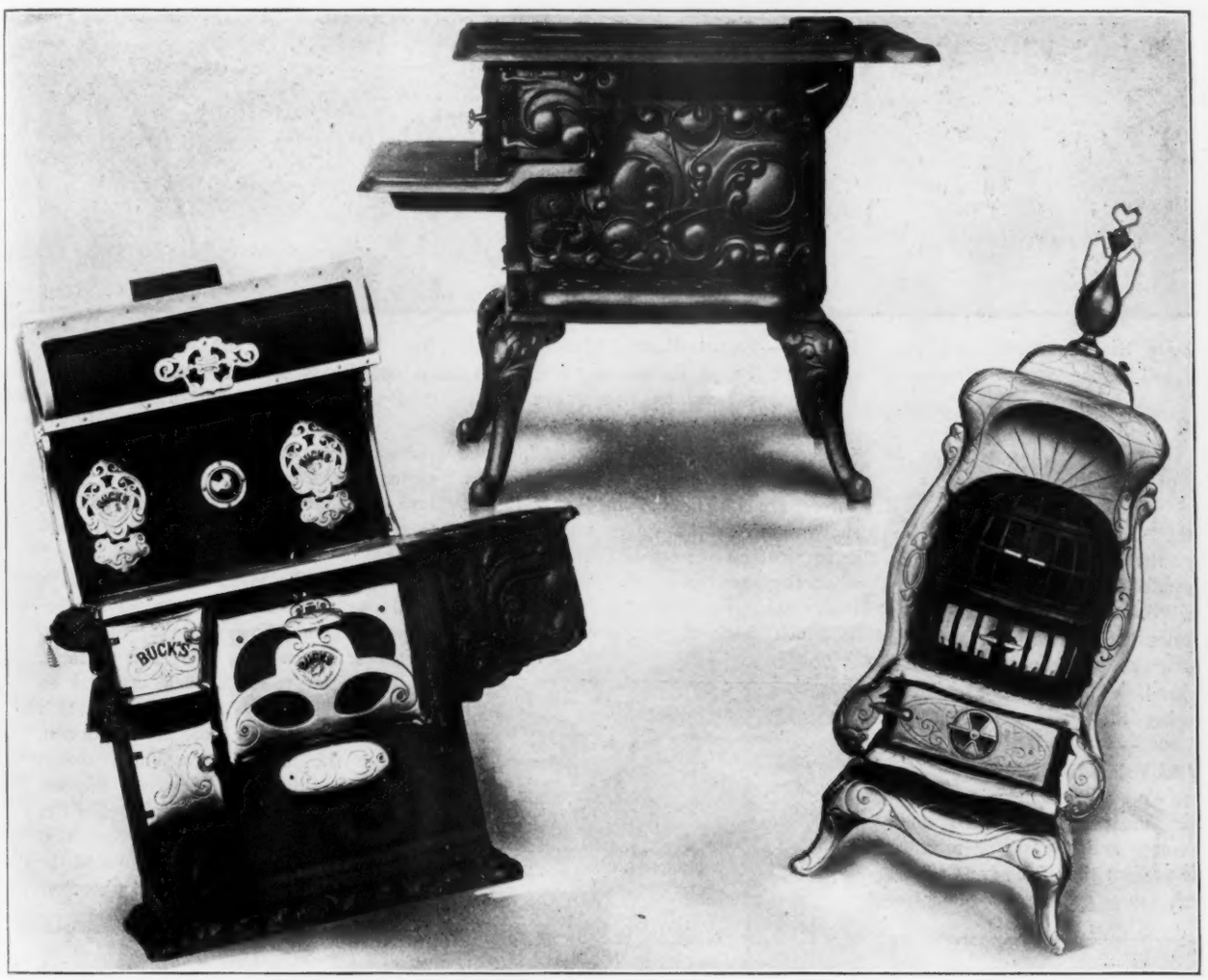


FIG. 12—CAST IRON COOK STOVE MADE ENTIRELY BY THE MATCH PLATE PROCESS

FIG. 11—ALL OF THE CASTINGS ON THIS STEEL RANGE WERE MADE BY THE MATCH PLATE PROCESS

FIG. 13—BASE BURNER MADE ENTIRELY BY THE MATCH PLATE PROCESS

Molding Methods.

In this foundry, molds for stove plate castings are made by four different processes. Aside from hand ramming, 14 match plate molding machines, built by the Arcade Mfg. Co.,

FIG. 14—DRAG SIDE OF ALUMINUM FOLLOW-BOARD BEFORE THE PATTERNS ARE MOUNTED

FIG. 15—FOLLOW-BOARD MATCH PLATE WITH BRASS PATTERNS ON OPPOSITE SIDES OF THE PLATE

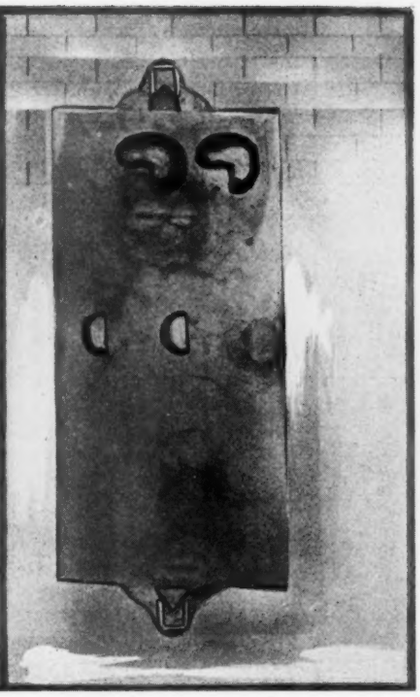


FIG. 16—COPE SIDE OF ALUMINUM FOLLOW-BOARD BEFORE THE PATTERNS ARE MOUNTED

Freeport, Ill., are used, as well as 24 squeezers, provided with guide pins at either end, which ram the cope and drag at the same time have been installed by the Adams Co., Dubuque, Iowa. In addition to the roll-up process described, aluminum match plates which cannot be rolled out of the mold are drawn up on rods driven into the sand, which serve as guides when drawing the patterns.

VALVE MIXTURES.

Question:—We are making special valves which must withstand 10 pounds steam pressure, and the metal mixture used at the present time follows: Copper, scrap sheets, tubes, etc., 80 per cent; tin, 6 per cent; zinc, 5 per cent; lead, 2 per cent; gun metal scrap, 7 per cent. The valves are satisfactory in the body but show radial cracks where tapped to receive stuffing boxes. Cracks develop when they are being machined, although the tap is not forced in and the metal is 3/16-inch thick around the neck. Has the scrap copper anything to do with our difficulty? What is the ordinary mixture for plumbers' brass goods and fittings, and would this answer our purpose?

Answer:—The mixture mentioned is a good one for making valves. I am inclined to think, however, that the scrap copper or the melting thereof is at fault. It is difficult to melt such material as this without excessive oxidation which would result in the trouble mentioned. Possibly the use of phosphorus would remedy the difficulty. I would suggest the use of two per cent of phosphor-tin, decreasing the ordinary tin by that amount. The mixture then would be copper 80, tin 4, zinc 5, lead 2, phosphor

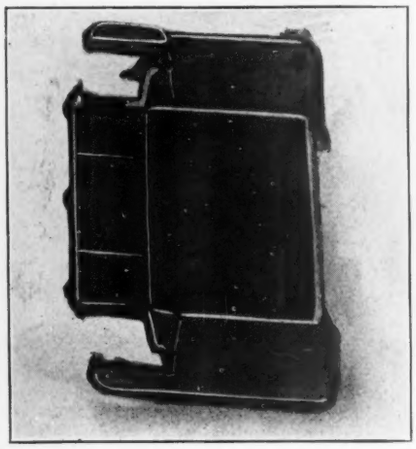


FIG. 17—TRIAL CASTING MADE FROM UNFINISHED ALUMINUM MATCH PLATE

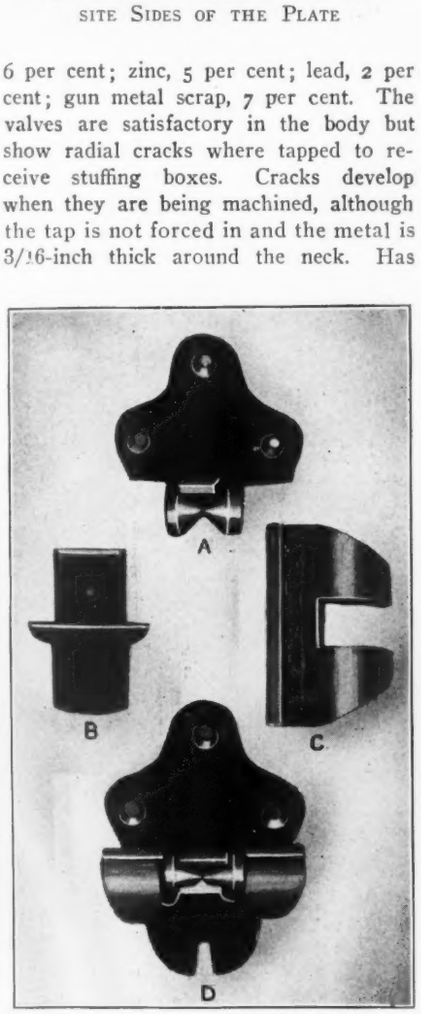


FIG. 18—THREE PARTS OF ROLL-UP HINGE ASSEMBLED AT D

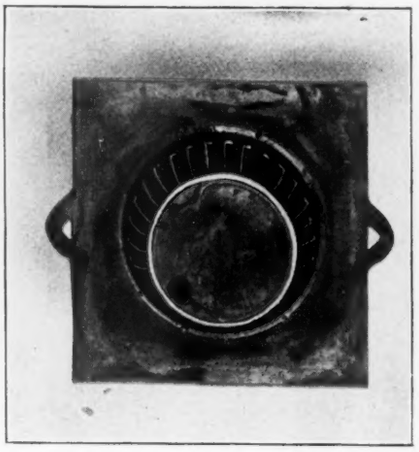


FIG. 19—ALUMINUM MATCH PLATE CONTAINING FIRE POT PATTERN

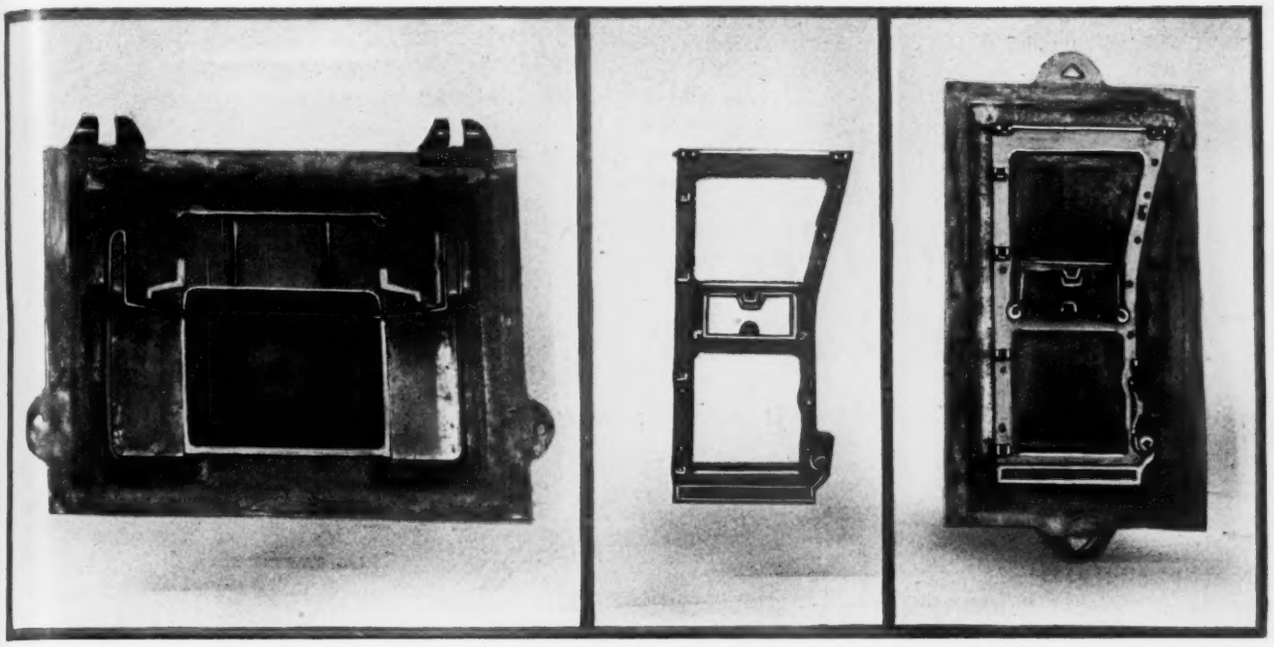


FIG. 20—HINGED ALUMINUM MATCH PLATE OF COOK STOVE HEARTH FRONT

FIG. 21—RANGE DOOR FRONT CASTING

FIG. 22—DRAG SIDE OF RANGE DOOR FRONT MATCH PLATE

tin 2, scrap 7. When phosphorus is used I would favor leaving out the zinc entirely, and if the castings are spongy it will be conclusive proof that it is a bad case of copper oxidation. To remedy this, cut the copper into small pieces and pound it into compact masses so that it will lie solid in the crucible and avoid the exposure of the metal to the atmosphere and furnace gases as much as possible. Use charcoal liberally, and one small handful of salt to each crucible. A highly recommended formula for valves contains copper 90, tin 8, and zinc 2. Another one that is widely used consists of copper 80, tin 5, zinc 5 and lead 5, as well as copper 80, tin 6, zinc 4 and lead 4. A good plumbers' red metal mixture follows: copper 85, lead 8, zinc 4 and tin 3.

K. K.

DIFFICULTIES WITH YELLOW BRASS.

Question:—We have been using a brass mixture which consists of copper 70 and zinc 30. A very small amount of lead is added to this and we have used some aluminum as a flux. We find however, that segregation occurs and that the castings are hard to machine. When aluminum is not used stifling fumes arise from the metal and it does not run so easily. We would like to have our brass run freely; it should be easy to machine and should be free from all imperfections.

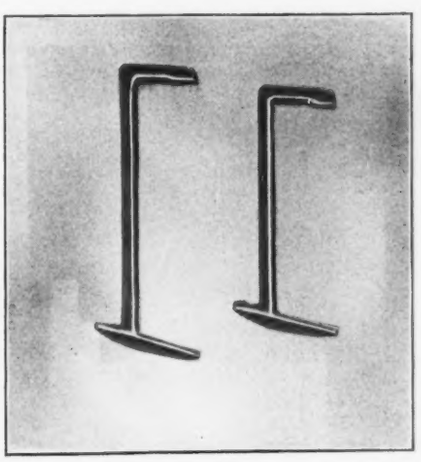


FIG. 23—FLASK CLAMPS

Answer:—Your formula should make an excellent yellow brass, although it is customary to add tin and lead thereto. Would suggest that you try copper 70 pounds, zinc 30 pounds, tin 1 pound and lead 2 pounds. The reason that your castings are difficult to machine is because your mixture is too low in lead. You might also try the following: Copper 40 pounds, zinc 15 pounds and lead 2 pounds. All yellow brass smokes when poured and it requires considerable skill to run good castings. The mixtures given are both used extensively with excellent results, and the metal will have to be cast while flaring and should be

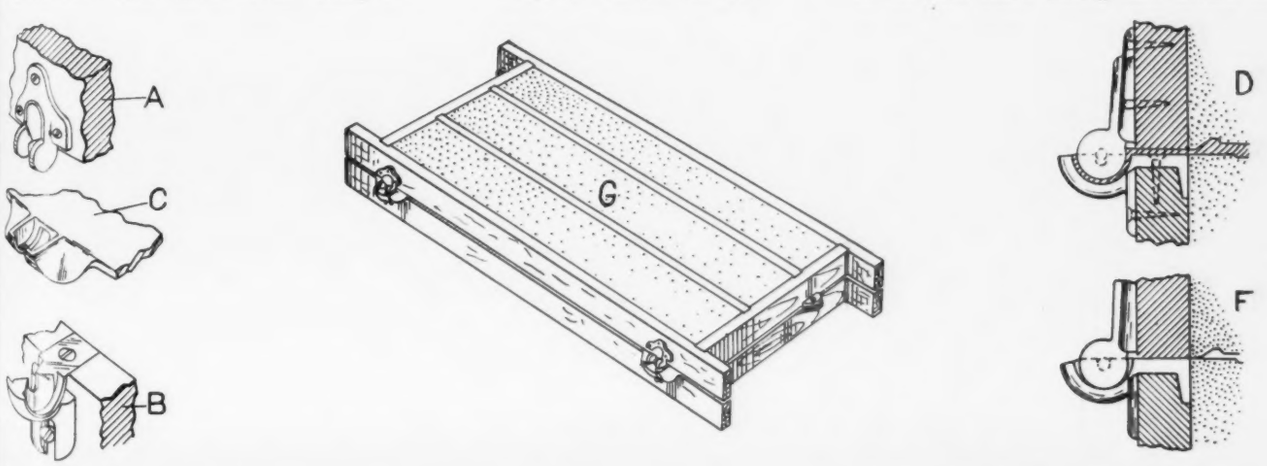


FIG. 24—PARTS OF ROLL-UP HINGE AND THEIR APPLICATION TO A FLASK. SECTIONAL VIEWS OF ROLL-UP HINGE ON A FLASK, SHOWING MATCH PLATE BETWEEN THE TWO HALVES OF THE FLASK AT D AND ROLLED OUT AT F

poured strong, keeping the runner full to prevent oxide marks on the castings. Aluminum has a tendency to make drossy castings, and although it makes the metal more easy to cast by imparting fluidity and preventing smoke or fumes, it has only a limited use for this work. Possibly you will find that you cannot use it in your work in which case it is advisable to employ skilled workmen who have had a wide experience in casting yellow brass. K. K.

Cincinnati Prepares To Entertain Foundrymen

Success of supply and equipment exhibit assured

PREPARATIONS for the foundrymen's convention to be held in Cincinnati, May 17 to 22, are going on apace, and from present indications the attendance will exceed that of any previous meeting. The number of foreign visitors promises to be large and one foundryman has signified his willingness to journey from far-off India to learn of the progress in American shops.

The success of the exposition of foundry supplies and equipment, which will be held in Music hall, under the auspices of the Foundry & Manufacturers' Supply Association, is already assured, and only a limited amount of space is still available. The various types of furnaces for melting the softer metals will be shown in operation in a large temporary building adjoining the hall, and the molds made on the machines exhibited will be poured in this annex. Many new molding machines will be displayed, inasmuch as the progress recorded during the last twelvemonth surpasses that of any like period in the history of the foundry trade. Despite the lull in trade conditions there have been marked developments in foundry practice, intended to increase efficiency and reduce costs.

The following concerns have already closed for space, although many additional reservations have been made:

Arcade Mfg. Co., Freeport, Ill.
Brown Specialty Machinery Co., Chicago.
Barnett, Oscar, Foundry Co., Newark, N. J.
Bartley, Jonathan, Crucible Co., Trenton, N. J.
Berkshire Manufacturing Co., Cleveland.
Birkenstein & Sons, S., Chicago.
Buch's Sons Co., A., Elizabethtown, Pa.
Carborundum Co., The, Niagara Falls, N. Y.
Crivel, Geo. F., Co., Buffalo.
Curtis & Co. Mfg. Co., St. Louis.
Detroit Foundry Supply Co., Detroit.
Detroit Testing Laboratory, Detroit.
Diamond Clamp & Flask Co., Richmond, Ind.
Dixon Crucible Co., Jersey City, N. J.
Falls Rivet & Machine Co., Cuyahoga Falls, O.
FOUNDRY, THE, Cleveland.
Foundry Specialty Co., Cincinnati.
Garden City Sand Co., Chicago.
Goldschmidt Thermit Co., New York.
Hauck Mfg. Co., New York City.
Hickman-Williams & Co., Chicago.
Hill & Griffiths Co., Cincinnati.
Herman Pneumatic Machine Co., Zelienople, Pa.
Killing's Molding Machine Works, E. Davenport, Ia.
Kroeschell Bros. Co., Chicago.
Macleod Co., Walter, Cincinnati.
McCormick & Co., J. S., Pittsburg.
Monarch Engineering & Mfg. Co., Baltimore.
Mumford Co., E. H., Philadelphia.
Obermayer Co., S., Cincinnati.
Oliver Machinery Co., Grand Rapids, Mich.
Osborn Manufacturing Co., Cleveland.
Paxson Co., J. W., Philadelphia.
Pridmore, H. E., Chicago.
Robeson Process Co., Au Sable Forks, N. Y.
Rockwell Furnace Co., New York.
Sly Manufacturing Co., W. W., Cleveland.
Smith Foundry Supply Co., J. D., Cleveland.
Sterling Wheelbarrow Co., Milwaukee.
Tabor Mfg. Co., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.

In an announcement recently sent to the members of the American Foundrymen's Association and allied organizations, Secretary Richard Moldenke makes the following request: "Bring your ladies. Particular stress was laid upon their entertainment at the recent meeting of the board of trade with our executives. The men will have their hands full at the sessions, as well as at the exhibition, and a special ladies' reception committee will dispense Cincinnati's famous hospitality to the ladies in attendance. It is intended to give a reception on Tuesday evening so that all may become better acquainted, while Wednesday will be devoted to business sessions, and Thursday afternoon and evening will be enlivened by a ride down the Ohio river to a pleasure resort, where the visitors will be entertained at a genuine Kentucky barbecue. The ladies will be entertained in the city."

Secretary Moldenke again directs attention to the fact that more papers are desired on topics relating to foundry practice, and requests that suggestions be sent him for subjects to be discussed.

In accordance with the resolution passed at the Toronto convention of the American Foundrymen's Association, the executive board has submitted the question of an increase in the annual dues, from $5 to $10, to a referendum vote. It has become quite evident that the prosperity of the association depends either upon a large increase in membership in order that the comparatively small annual dues may suffice to carry on the work properly, or the dues must be advanced to a point where it is possible to give the membership a substantial return in the form of valuable foundry literature. The rapid increase in membership during the last few years has greatly increased the convention expenses, and a greater income is necessary, which should largely be devoted to the publication of foundry literature. It is the opinion of the executive board that the membership should be increased and the annual dues advanced.

ALLOY FOR HARDENING GRAY IRON.

BY W. J. KEEP

Question:—Is there any product which will make soft cast iron extremely hard, similar to chilled iron when added in the ladle? We are melting No. 3 foundry iron, and would like to pour a heat of extremely hard castings.

Answer:—Spiegeleisen can be added and will make the castings very hard, but you will not secure the chilling effect. You cannot add a very high percentage in the ladle as it is extremely difficult to melt except at a high temperature. A considerable quantity of thin steel punchings can be added in the ladle and stirred in with an iron rod, and if the castings are very small it is probable they will show a white fracture. The only practical way, however, to produce chilled castings is to reduce the silicon in the mixture.

TRI-CITY FOUNDRY FOREMEN.

At the monthly meeting of the Tri-City Associated Foundry Foremen, recently held at the Harper House, Rock Island, Ill., E. W. Smith, of Chicago, delivered an address on association work and urged the members to attend the Cincinnati convention if possible. Dinner was served before the business session was held.

THE SAND BLAST IN THE FOUNDRY---V

Safety appliances recommended for the sand-blasting department --- Cost of installation and operation --- General suggestions

BY JAMES M. BETTON

IN SAND-blasting, the force of the blast causes a rebound of the particles of sand, with sufficient force, if of a coarse grade, to sting severely, or even cut the face of the operator, as well as to fill his eyes and cause serious discomfort.

It is usual to prevent this by wearing a helmet of canvas with a curtain depending from the brim which may be drawn in about the operator's chest by suitable strings. In the front of the helmet is an opening, covered with glass, which is of little value as it soon becomes rough. Mica or celluloid is better, although both are more or less cloudy. A fine mesh wire screen, which is very durable, admits some dust, but as it also permits a free circulation of air it is on the whole, the best. Some helmets are arranged with a nipple on top to receive a ¼-inch rubber tube carrying air from the main supply down into the helmet, and as the sweat band is set out from the shell by means of corks in all helmets, the air flows freely around the operator's head. The main objection to this form of helmet is that the attached tube limits the area of action of the operator and he often will not, or cannot get in as good a position to reach the castings as with a detached helmet. This style of helmet reduces the trouble from dust somewhat, but by no means entirely.

Like many safeguards, the helmet is not popular with the average operator, especially in hot weather when he finds it uncomfortably warm, and if he is addicted to the use of tobacco, it interferes with his customery freedom of expectoration and is liable to be laid aside.

An ordinary wire mask or "false face," which can be obtained at any toy store, answers very well as a protection for the face and eyes, gives plenty of air and permits of vision in any direction. They are not expensive, and are used by stone cutters operating pneumatic surfacing machines and should be used oftener with the sand blast.

Use of a Respirator.

If the sand is poor, full of clay, loam or dust, and the ventilation of the cleaning room is faulty, the use of a respirator, whether of rubber with enclosed sponge, or a large sponge, wetted and tied over the nostrils and mouth of the operator, will be found to give some relief, and if properly adjusted, frequently washed out and cleaned, it is of value; but as these appliances are almost invariably attached carelessly, used intermittently, and often afford a very certain medium for encouraging and spreading influenza, their use is not desirable except in special cases.

In the well designed cleaning room the dust flows away from the operator continuously, and in a few seconds after he ceases work it has been displaced by clean air. In such rooms the work of sand-blasting is not unhealthful.

The fact remains, nevertheless, that no man should be allowed to work any sand blast continuously, who is inclined to pulmonary troubles, for by the irritation of the dust, the mucous membrane becomes involved and affords an opportunity for germs to thrive. A man with a heavy cold or temporary cough should be transferred to other work until he is well, and with some attention paid to these details there need not be trouble from dust, which like many other ills can be prevented either wholly or in part.

Other Safety Appliances.

In many instances, the only protection required for the face can be obtained by the use of ordinary glass goggles, which can be purchased at a small price and which give good protection and allow of free working. The face becomes accustomed to the sting of the sand under low pressures and goggles can be used, especially by the foreman, in inspecting the work of cleaning.

With high air pressures the hands may suffer from the cutting of the sand, but any kind of gloves will prevent this, old buck-skin, woolen, canvas or cloth gloves are as equally protective as the more expensive rubber gauntlets. Any of them will wear rapidly from handling castings and the cheapest will often last as long as the most expensive.

A good exhaust fan or blower, of ample capacity, is the best safeguard to the operator of the sand blast and does more to promote his health and comfort than any other appliance that can be used.

Playing with the sand blast, by taking a shot at a passing workman, is dangerous and should be guarded against, as a man's eyesight can be easily destroyed by a grain of sand or a small stone flying at a high velocity.

In many foundries the sand blast is looked upon as some strange and unfamiliar machine, unfavorable to the operator, with the result that none but the lowest grade of labor will handle it willingly. That this condition of affairs has come about is due to the faulty and even criminal arrangement of some cleaning rooms, in which no man should be asked to work, but these are passing away quickly, because it has been found that the work could not be as well done in a cupboard, in which the dust was so thick that the man could not see his hands, as in a decently lighted and ventilated cleaning room.

This impression should be discouraged and as capable a man as can be found detailed to the work of sand-blasting which is such that, a man who can lay out his day's work intelligently can do more than one who takes the castings as they come to him, and with a better class of operators the average cost per pound of cleaning will be reduced.

Cost of Operation.

Actual figures regarding the cost of operating the sand blast per pound of castings cleaned, are difficult to obtain and are not of great value for comparison. There are few foundries making the same class of work, the conditions of operating vary in every case, and the cost of producing the air pressure varies with the type of compressor used, but it is to be hoped that more careful records of costs will be kept of this work, from which the necessary data may be obtained.

That the sand blast is of value is evidenced by its daily adoption by foun-

dries hitherto unprovided with this equipment, and its labor saving value, as an investment, is shown in the following approximate estimate, based upon the installation of a sand blast in a foundry not before provided with air. It is based on the operation of the sand blast by one man with the assistance of a laborer one-half of the time, to handle castings, sand, etc.

If we further estimate the quantity of

Sand blast	$ 300.00		
Compressor and air receiver	600.00		
Foundation	50.00		
Piping	60.00		
	$1,010.00		
Cleaning room	250.00		
Total cost	$1,260.00		
Interest on investment.		$ 75.60	
Depreciation and Repairs, 10 per cent....		126.00	
			201.60
Labor, 300 days at $2..			600.00
Power, 10 horsepower at $60.00 per annum...			600.00
Extra Labor, 150 days at $1.50			225.00
Sand, 75 tons at $2...			150.00
Total Annual Expense			$1,776.60
To offset this is the time of 6 men, 300 days, at $1.75.....	3,150.00		
Estimated saving per year, or about 100 per cent. upon the investment			1,373.40
Total			$3,150.00

castings cleaned as 20 tons per day, or 6,000 tons per year, the actual cost of cleaning will be about 30 cents per ton.

General Suggestions.

Having selected a sand blast of sufficient capacity to do the work without too frequent halts for refilling, and arranged a place suitable to work it in, bring to it the air delivery pipe, taking care that it is large enough to connect to the sand blast without any reduction. Put in a good gate valve just back of the sand blast, as it may be found convenient to remove the latter at times; a union joint will enable this to be done without trouble and delay. Have ready a supply of sand or fine gravel that is so dry that no trace of moisture can be felt upon the hand. The sand blast being connected and the sand valve closed, screen upon the floor enough sand to fill the tank, using a screen of 8 or 6 mesh, according to the size of the sand, to remove any large pebbles, sticks, nails, paper, etc., and fill the sand tank full, closing the filling hole securely.

The sand blast is now ready for operation and the operator having put on a helmet or other form of protection, if no cleaning box is used, opens the air valve admitting air to the sand tank. If a reducing valve is used, the pressure is now regulated to the proper point. Open the sand valve gradually until enough sand is delivered through the nozzle to give the best cutting effect, which can be quickly determined by holding the nozzle about six inches from the casting. After a few trials, the operator can easily judge by the eye whether the quantity of sand is sufficient, bearing in mind that a moderate quantity, of which each particle is individually acted upon by the air pressure, is of more value than a large amount of sand in which the particles are crowded together and individual effort smothered. A small number of men rushing through a narrow gate can break through a crowd quicker than a multitude, each pressing against the other. If the sand and air are in proper regulation, the sand blast should be capable of working steadily until the sand is all discharged. While this takes place, and it can be known in the dark by the change in the sound of the escaping air, which becomes sharper when not carrying sand, the sand valve should be shut off first, to allow any sand that may remain in the hose to be blown out. Then shut off the air and allow the air pressure in the sand tank to fall before attempting to open it for the purpose of refilling. A large sand tank will hold a considerable quantity of air, and if the only chance of discharge is through the delivery hose and a small nozzle, it can be emptied quicker by attaching an air cock at any convenient point in the upper part.

Air Pressure in Sand Tank.

An air pressure in the sand tank, equal to or balancing that under which the blast is operated is necessary to enable the sand to flow freely. If the pressure were not balanced, a small quantity of sand would fall, by gravity, into the delivery mechanism, and, when enough had flowed out, a vacuum would form in the upper part of the tank, the air pressure would back up to fill this, blowing the sand up into the tank, and interrupting its flow.

With a small nozzle, stoppages may occur from a pebble, flat stones, paper, etc. passing through the hose of the nozzle. This is due only to careless screening of the sand and can be entirely prevented by proper attention being given to this simple and necessary precaution. If the nozzle plugs, it is safer to shut off the air pressure immediately and relieve it by the air cock on the sand tank, for if the hose is worn there is danger of bursting it. The pressure having fallen, the nozzle can be quickly removed and the cause removed. It is not safe to attempt to push this back with a wire, which is but wasting time as the pebble is bound to come back against the nozzle in a short time.

Damp Sand.

If the sand is damp and will not flow, shut down the sand blast and take out all of the sand there may be in it, through the opening or plug provided for this purpose. The quicker this is done the sooner the machine will be ready to work again. Damp sand cannot flow and no sand blast can handle it, and the quicker it is removed and replaced by dry the better.

Put the sand blast in charge of a competent man, show him the working points, see that he handles it to the best advantage, give him the necessary screens, shovels, brooms and all facilities for handling large castings, such as an air hoist or an overhead trolley, a suitable working place with ample provision for removing the dust, and the results will be satisfactory.

On the other hand, if the sand blast is placed in the hands of an ignorant laborer, chosen because he cannot object, who has to work in a cramped, dark hole without ventilation, or but partly ventilated, without any material assistance from the foreman, who looks upon the machine as a "man killer," it will not be remarkable if the results obtained are not satisfactory, and the sand blast condemned.

The sand blast is a good tool, capable of doing well more lines of work than are now credited to it and, with reasonably intelligent use and ordinary supervision and care, will more than justify its installation.

MAKING A CAST TOOTH GEAR FROM A BLANK PATTERN.

By Jabez Nall

Owing to the perfection attained in the manufacture of high speed automatic gear cutting machinery the cast tooth gear is being relegated to the

Fig. 1—Part Section of the Blank Gear

rear and is in danger of becoming altogether obsolete. In many places where formerly used it has been discarded, and when it is presented occasionally for repairs or the fitting of some special centers, with no pattern in stock, a cheap casting must be produced to meet the emergency.

Having at hand a blank gear pattern near the size, this could be used to make the cast tooth gear in two ways, by either lagging around the full face of the wheel or by passing a short segment around the face while molding, thus forming a core print, then making cores with a limited number of teeth to be set into the print thus formed. This method re-

quires careful work in the core room, and the molder must exercise care in setting the cores.

A better method, giving a green sand finish to the whole casting, eliminating all fins from contact of cores and consequent chipping in the cleaning department, is shown in the accompanying sketches. Fig. 1 shows a part section of a blank gear; Fig. 2, a plan view of a segment of 10 teeth to be used in connection with blank pattern; Fig. 3, a cross section on the center line of the segment and part section of the mold.

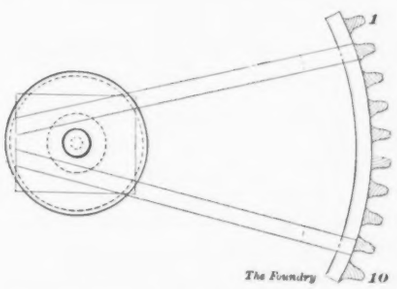


FIG. 2—PLAN VIEW OF SEGMENT OF 10 TEETH TO BE USED WITH THE BLANK PATTERN

Molding.

The blank pattern is molded in the usual way, except that the molder does not need to be so careful of that part of the mold forming the face of the wheel as this is first rammed up only to form the parting line for the cope. After the cope is lifted off this part is dug away for about four inches from the face of the pattern to allow for ramming and the placing of nails to reinforce the sand between the teeth, as shown at B, Fig. 3.

The blank pattern is next withdrawn with the exception of the bottom or drag hub, and the center pin of this hub forms a center upon which to revolve the segment when placed as shown. The molder should first try this around to check the work of the patternmaker in spacing the teeth. A slight variation of the radii may throw him out at the last tooth, but this can easily be rectified at the start, section A being made adjustable for this purpose.

The segment is now rammed up, the sand being reinforced as previously indicated, and properly vented. The segment is withdrawn and moved around placing the tooth 1 in the space left by tooth 10, the operation being repeated as often as is necessary to complete the circle. In this case the wheel has 68 teeth and at the final setting the teeth will fit into the two end spaces. With this operation finished the mold is ready for closing and made ready to receive the metal.

CUPOLA OPERATION.

By W. J. Keep

Question:—We operate two cupolas driven by one blower, the blast pipe being about 30 feet long with a Y and cut-off for each cupola. Our castings have been high in sulphur and the cupola tender insists that holding the iron in the furnace has a tendency to increase its temperature. The small cupola has a shell diameter of 72 inches and is lined to 55 inches. From the bottom of the tuyeres the height is 22 inches, and from the tuyeres to the charging door, eight feet. The blower outlet is 16 inches. This cupola has eight tuyeres, 8 x 4 inches. The large cupola has a shell diameter of 84 inches and is lined to 62 inches and the height from the bottom to the tuyeres is 26 inches, and from the tuyeres to the charging door, 10 feet. The blower inlet is 16 inches and the cupola is provided with the same number of tuyeres as the small cupola. It is evident to us that our coke consumption is entirely too high and it is necessary for us to reduce our sulphur. Our principal line of work is heavy machinery castings, although we occasionally produce light castings which are very brittle.

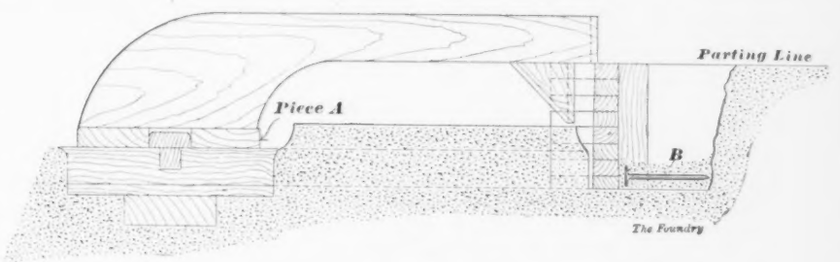


FIG. 3—CROSS SECTION ON THE CENTER LINE OF THE SEGMENT AND PART SECTION OF THE MOLD

Answer:—Your cupolas are correctly proportioned for machinery castings, but your cupola tender is entirely wrong regarding the temperature of the iron. The bed should be lighted two hours before the iron is needed so that the lining may be raised to a high temperature. After the iron melts and drops below the tuyeres, it can receive no additional heat. If the cupola walls below the tuyeres are not at a melting temperature when the iron begins to come down the first iron will be dull. If you commence with a hot cupola the quicker you tap the iron the hotter it will be. To secure a low percentage of sulphur melt rapidly with a very hot cupola and tap the iron as quickly as possible. You should charge 40 pounds of limestone for every ton of iron. The less coke used, if the iron is hot, the lower the sulphur. Light your fire with plenty of wood two hours before the first tap of iron and charge enough coke to reach 20 inches above the tuyeres. One-half hour before tapping, charge enough coke to bring the coke back to 20 inches above the tuyeres and charge 4,000 pounds of iron. The next coke charge should be about 260 pounds and 3,000 pounds of iron, and the coke should be further reduced on the last two charges. This will result in fast melting with low sulphur, a low melting ratio and very hot iron. While you do not give the blast pressure it should not be less than 14 ounces. When you line your cupola again make your tuyeres as wide as the openings in the shell and flare them on the inside. By making the tuyeres nearly continuous you will secure much better results. Be cautious in making changes and exercise care to prevent the charging of dirt in the cupola. Break the scrap as small as the pig iron until you get in the way of good melting. To make your light castings stronger, increase the silicon, but the fact that the two cupolas are blown from one blower does not prevent good results. We doubt whether your blower is of sufficient capacity and believe that the outlet should be about 26 inches in diameter, the branch to the large cupola 20 inches in diameter and that to the smaller cupola, 18 inches in diameter.

SAND BURNT CASTINGS.

By W. J. Keep

Question:—We have experienced considerable difficulty in making the sand peel from castings which average about one inch in thickness. The castings are highly ornamental, which necessitates the use of a parting compound on the pattern and blacking dusted on the molds will not adhere owing to the presence of the parting compound.

Answer:—Mix seacoal with your sand and pour the iron as dull as possible. If the silicon percentage is fairly high little trouble will be experienced from the sand adhering to the castings.

ENAMELED CAST IRON SANITARY WARE--II

The method of making sheet lead and wood bath tub patterns is comprehensively discussed in this article

BY DILLEN UNDERHILL

AFTER the design has been decided upon, the production of the pattern is the first step in the manufacture of a bath tub. Before the pattern is started and to insure the proper shrinkage allowance, it should be ascertained whether only a working pattern is to be made, a working pattern and a master pattern, or a working pattern, master pattern and a grand master pattern. To understand more clearly why these conditions prevail and are of importance to the pattern-maker it might be well to cite actual cases. A large jobber of tubs believes he can sell a new design and he has a working pattern only made according to his ideas. As he is compelled to pay the cost of this experiment the manufacturer endeavors to make the working pattern with the least expense to the jobber. If a new rim only is desired an old pattern may frequently be fitted with wood core prints screwed to the rim, and cast iron or wood core boxes can be made to core out the desired shape for a working pattern. While this is only a makeshift for getting out a single pattern, nevertheless it frequently answers the purpose as well as if a lead pattern had been made. In some foundries, working patterns are frequently made from other working patterns and for this reason we frequently see five-foot tubs from the same maker which are neither the same length nor width. It can readily be appreciated what this method would lead to if frequently repeated.

Lead and Wood Patterns.

If a new design of the body of the tub is desired at least two patterns are necessary. A lead or wood pattern is first made and from this all of the working patterns are constructed. If the sales show only a fair demand for this style of tub only the master or lead pattern and the cast iron working pattern are built. Furthermore, if the tub is to be molded by hand, invariably only these two types of patterns are made. When the demand for a certain style tub is heavy, those that are hand molded frequently have a grand master lead or wood pattern, a cast iron master pattern and last, a cast iron working pattern. All tubs which are made on machines are provided with these three types. After the lead pattern has been altered for the various sizes desired, it is advisable to melt up all parts except the large section of sheet lead inasmuch as there is little danger of the cast iron master pattern being broken, and it does not pay to keep the lead grand master pattern about the shop.

When the shrinkage has been determined the pattern thickness, whether made of lead or wood, must be decided upon. Outside of these two details the method of proceeding with the first pattern is practically the same in all cases. For this first pattern, one of two materials is used for the pattern itself, wood or sheet lead. In each case, however, a built-up wood form and follow-board of the same shape are used.

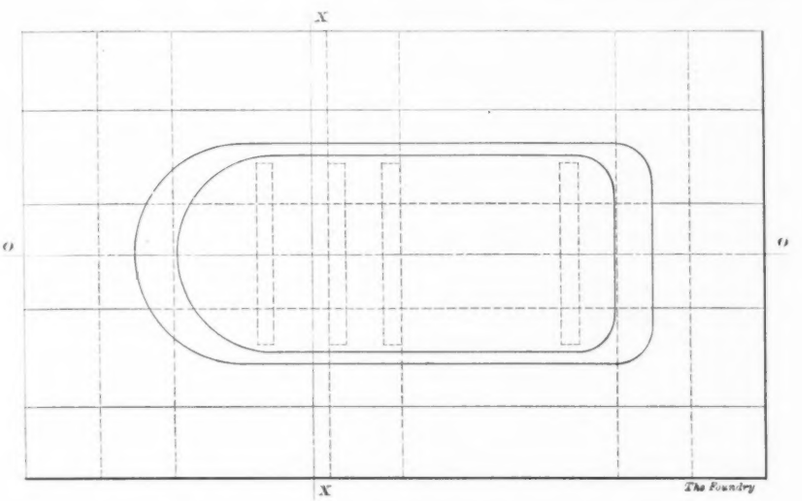


FIG. 1—PLAN OF FORM AND FOLLOW-BOARD FOR LEAD OR WOOD PATTERN OF A 5½-FOOT BATH TUB

Pattern Form and Follow-Board.

In Figs. 1, 2 and 3 is shown in detail the construction of a 5½-foot pattern form and follow-board. The latter is built up of two-inch boards, surfaced on four sides and nailed to three 2 x 8-inch pieces to hold it firmly together. In spacing these cross-pieces they should be placed as shown in Figs. 3 and 4, so that when the wood form is shortened, as shown in Fig. 4, the lag screw at A will not pass through the cross pieces, but only through the follow-board as shown. If the cross-piece is placed too far toward the head of the pattern, it will be necessary, when shortened the second time for the 4½-foot tub, to use longer lag screws than for the five-foot and the 5½-foot patterns, or to carve down into the cross-pieces to get the lag screws to hold the form securely to the follow-board. Occasionally the follow-board is made of material less than two inches thick, but the saving in lumber is more than offset by the excess filing of the cast iron pattern necessary if a warped casting results from the follow-board not being properly bedded in the foundry floor, as when the sand is rammed, the follow-board being flexible, becomes distorted.

Follow-Board.

For a 5½-foot tub, a follow-board, 4x8 feet, is desirable but not necessary. A suitable flask is usually secured which will answer the purpose with a few minor alterations, and the follow-board can readily be made to conform to the flask. It should be borne in mind that only one casting is made from this original pattern, and therefore it is necessary

to make it as cheap as possible. The follow-board is first constructed and after the top has been planed and levelled to a smooth surface, a plan of the tub around the rim, the shrinkage having been allowed for, is scribed on this top surface and inside of this is built the form. The ends of the form are then built up, placed in position and fastened to the follow-board with lag screws. The ends are built up level to the joints B C, Figs. 3 and 4, before being set in place, and after being secured, the center boards are tacked in position and the top and sides are fastened in place and planed down to the required form.

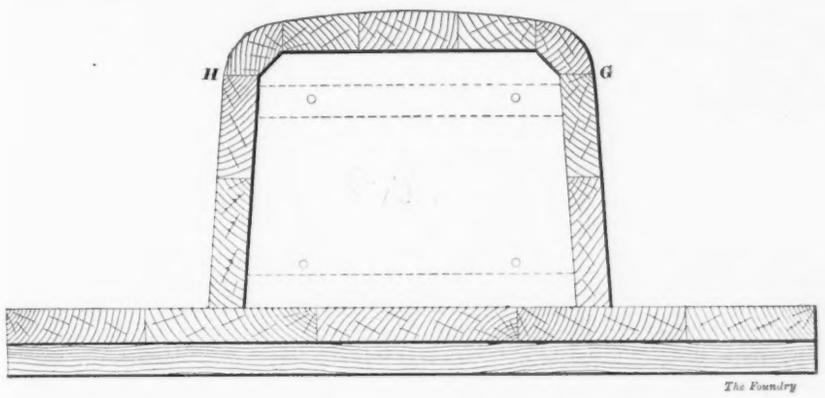


FIG. 2—CROSS SECTION OF FORM AND FOLLOW-BOARD OF A LEAD OR WOOD, 5½-FOOT BATH TUB

Provision for Reducing Pattern Form.

It will be noted that the center-board D, Fig. 3, is set six inches, face to face, from the head end section F, and center board E is set 12 inches the other side of F. This is necessary when it is desired to cut down the form from a 5½-foot to five-foot and 4½-foot patterns. The smaller sizes are almost always ultimately required even if it is not thought advisable to make provision for them when the tub is ordered. It costs so little more to insert these pieces that it is good practice to set them in position accurately. Sometimes a five-foot pattern is ordered and in this case the form should be built as shown in Fig. 4, so that it can be either shortened or extended. The side and end boards naturally would not be made in two sections, but would run full length as shown in Fig. 3, for the 5½-foot size.

When the 5½-foot form has been covered on the sides and bottom, small wood templets of the curves are made for both ends of the forms for the foot curves at H and G, Fig. 2. These curves are joined lengthwise by straight surfaces and are lined up with a straight edge. Templets are also made for the ends of the form at B and C, Fig. 3, and the intermediate curved surfaces are planed to join each other with easy curves. It pays to put the forms together with screws, as the tops and sides can usually be used again.

Reducing the Pattern Form.

In reducing the 5½-foot form to a five-foot size, the form is taken from the follow-board, sawed in two close to the surface F, Fig. 3, leaving sufficient stock to plane up a tight joint when brought together as shown in Fig. 4. The remaining stock should also be sawed off close to the center board D, and similarly planed. Sections D and F are then fastened together with lag screws as shown in Fig. 4. In moving up the head section it will be found to be too low to make a neat joint on account of the slope in the bottom of the tub which is provided for drainage. This section will, therefore, have to be raised and a thin piece of wood placed between it and the follow-board, and this section must then be planed to conform to the new curve owing to the change of cross section. As the change is slight, it does not involve a very great expense to change back to the 5½-foot form if necessary, but this is rarely done. In a similar manner the form can be cut down for a tub 4½ feet long, but a four-foot tub is not in demand nowadays.

The Lead Pattern.

The method of making the lead pattern will first be discussed inasmuch as this material is now generally employed for this work. In Fig. 11 is shown a lead pattern almost completed. For all flat surfaces as well as the larger curved surfaces, sheet lead is drilled and bent down to fit snugly against the heavy wood form. Sheet lead, ¼ or 5/16-inch in thickness is used, depending on the shrinkage and the ramming of the pattern. As the lead pattern is heavy to handle the sand is not usually rammed as hard as against a working pattern, and it has been found that a casting from a lead pattern has a slightly greater thickness than one made from a working pattern of the same thickness, and as a minimum amount of filing is desired the thickness of the cast iron pattern must be taken care of in the lead pattern. The sheet lead before being applied is chamfered off at an angle of about 45 degrees all around the sheet, and the sharp edge side is laid against the wood. Before the sheet lead is set in place holes for screws are drilled on a small high speed drill press so that the edges will not turn up when bent to place with a wooden mallet. Wood screws, Nos. 9 to 12 and 1½ inches long, are of sufficient size to hold the sheets in place, and a 5/16-inch washer is used under the screw head.

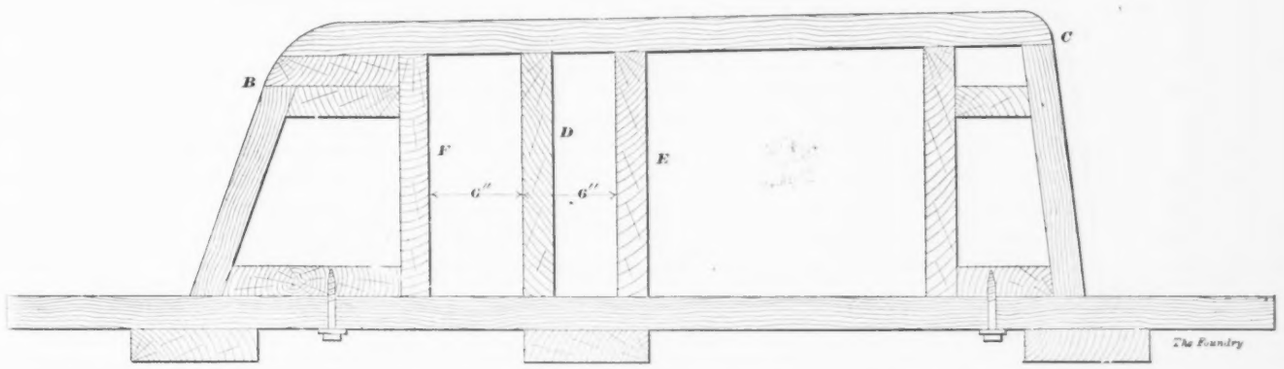


FIG. 3—LONGITUDINAL SECTION ON THE LINE O O, FIG. 1, OF THE FORM AND FOLLOW-BOARD OF LEAD OR WOOD PATTERN FOR A 5½-FOOT BATH TUB

Certain sections of the pattern such as the rim, the outlet, and sometimes the small foot-end corners, cannot easily be formed out of sheet lead, and for these, small wood sections must be made up other. A section of the rim for the side of the top is shown at Y, and is conveniently cast into sections about one foot long. A section of one of the foot-end corners is shown at Z and usually all to make a number of castings before a perfect one is obtained. A pattern or a casting for the foot-end corner curves is shown in Fig. 9, and as these duplicate they are cast the same as the rim. In

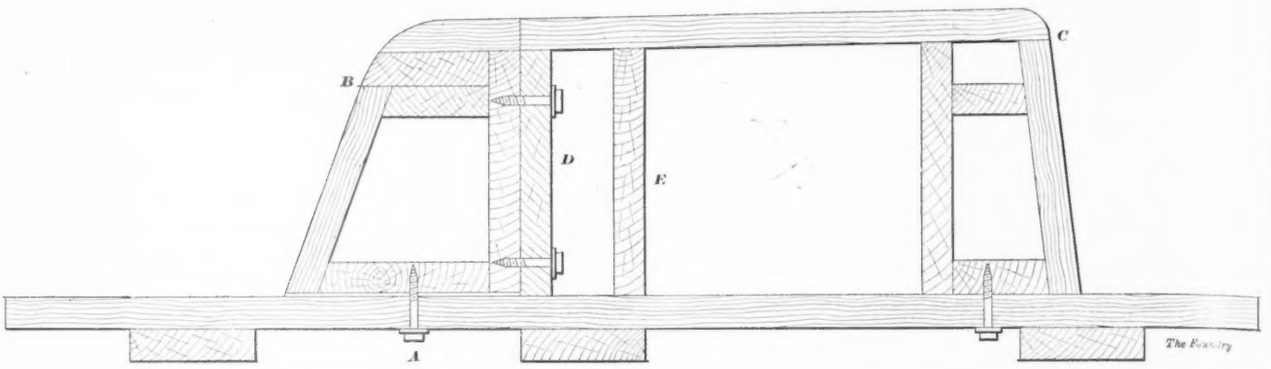


FIG. 4—LONGITUDINAL SECTION OF FORM AND FOLLOW-BOARD OF A LEAD OR WOOD PATTERN FOR A 5-FOOT BATH TUB

and from them white metal castings are produced. Sections of the rim are shown in Fig. 5. The section of the head end of the tub is shown at X, and if the rim is a perfect circle this can be made either a third or fourth of the rim, and when secured in place to the follow-board can

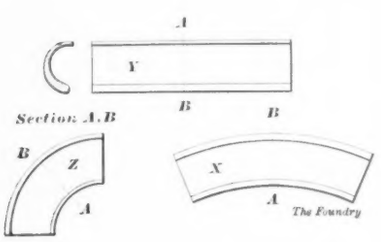


FIG. 5—SECTION OF RIM; Y IS THE STRAIGHT SECTION OF THE RIM, Z IS THE CURVED FOOT END AND X IS THE HEAD END OF THE BATH TUB RIM

be soldered to each other and to the sheet lead, forming the body of the pattern. If, however, the end is a variable curve, it must be cast in two pieces, of which one will be the opposite hand of the castings are made from a single pattern. The ends of these white metal patterns should be scraped or filed so that they can be easily soldered. The composition of the white metal mixture follows: lead 80, antimony 8, tin 12. Clippings from the sheet lead should be saved and can be used in this white metal mixture.

Melting the White Metal.

When melting the white metal a cast iron ladle, Fig. 13, with a handle 30 inches long is used. The ladle should have a capacity of three or four quarts and can be heated over a gas burner similar to those used in house heating furnaces. A temporary circular furnace built of fire brick, about 18 inches high, can easily be provided for melting this mixture in the ladle. A cheap flask that can be easily made for molding the white metal patterns is shown in Figs. 6 and 7, and a section of the same is shown in Fig. 8. The mold should be well vented as the white metal cools quickly and if retarded in its flow, will draw away from the casting. A heavy riser and sprue should also be provided. This metal has a high shrinkage and occasionally it is necessary

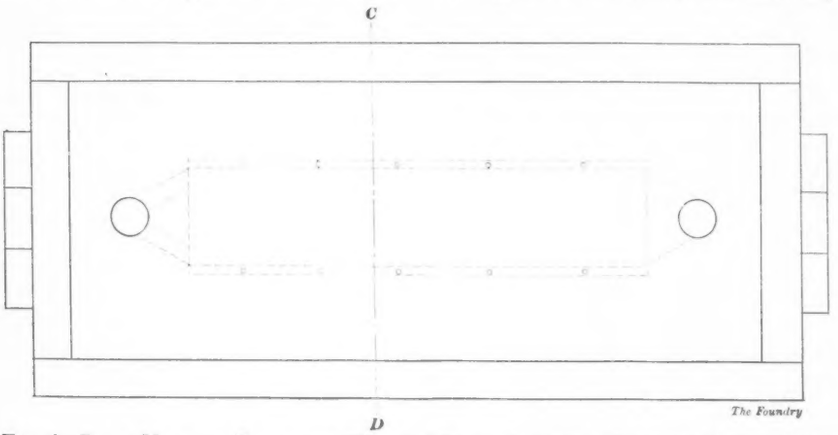


FIG. 6—PLAN VIEW OF FLASK FOR WHITE METAL CASTINGS, SHOWING VENTS, RISER AND SPRUE

Fig. 10 is shown the castings or pattern for the outlet.

Soldering the Castings to the Sheet Lead.

If a fine grade of molding sand is used these castings usually require no filing, outside of the cutting off of the gates

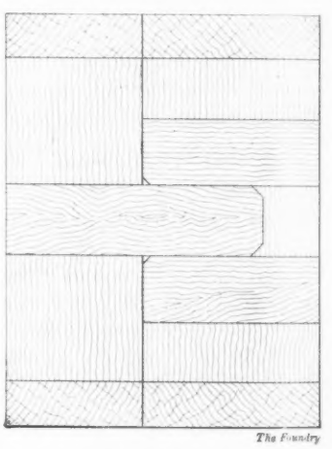


FIG. 7—END ELEVATION OF FLASK

and the removal of the wire-like fins made by the vents. The ends which are to be soldered should be filed. It is best to make these castings first and to put them in place before starting with the sheet lead work, so that the latter can be fitted to the castings. It would be unwise to cut the lead after it is screwed in place against the wood form inasmuch as in cutting the lead the form would be dented or notched and the lead or solder would get a hold in these cavities and make it difficult to take the pattern from the form when soldered up and the screws have been removed. When the parts have been secured in place, the white metal castings and the sheet lead are all soldered together. For this purpose a copper soldering iron is used. Three soldering irons weighing eight or ten pounds

can be used to advantage with a gas furnace. These enable the operator to have a hot iron in use while the others are being heated.

After the castings are soldered to the

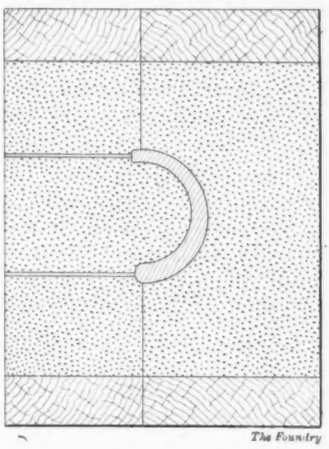


FIG. 8—SECTION OF FLASK AND RIM AT C D, FIG. 6

sheet lead, the wood screws and washers holding the pattern to the form and the follow-board are removed and are placed in a box or drawer to be used over again. The pattern is then ready to be taken from the form, and as the lead pattern usually sticks to the form it is necessary to have a chain hoist of at least 1,000 pounds capacity to turn over the follow-board, form and pattern. These are then suspended with the pattern only a few

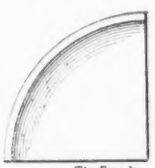


FIG. 9—FOOT-END CORNER USUALLY ONE-EIGHTH SECTION OF A HOLLOW SPHERE

inches from the floor and by striking the pattern with a wood mallet it is released from the form and drops to the floor. From the chain hoist can also be suspended the sheet lead which comes in rolls, and by placing a round bar through the roll the lead can be unrolled as desired.

Finishing the Pattern.

After the pattern has been removed from the form it will be seen that the solder is not smooth on the inside nor are the joints perfect. It is, therefore, necessary to fill up the cavities which appear on the inside and to finish the joints. Both the inside and the outside of the pattern must be scraped perfectly smooth so that the pattern can be easily drawn from the sand. The sheet lead will usually have a sufficiently smooth surface, but all joints inside and outside should be scraped.

Owing to the difficulty frequently experienced in securing a good grade of solder consisting of half lead and half tin, it is advisable, owing to the large

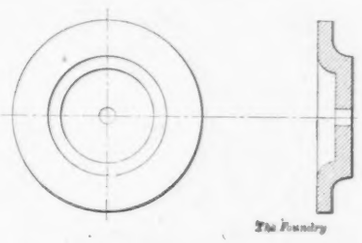


FIG. 10—PLAN AND SECTIONAL VIEWS OF THE TUB OUTLET CASTING

amount of lead scrap made in making these patterns, to cast the solder required for this work. The mixture is melted in a ladle shown in Fig. 13, and is poured into a cast iron mold shown in Fig. 12. Both the ladle and the casting can be easily made and they pay for themselves in a very short time. The molds are arcs of a circle and the solder when cast readily falls out when the cast iron mold is reversed. If the mold is made 1½ inches thick it will remain cold long enough to cast a large number of sticks of solder without being too hot to handle. The grooves have a radius of ¾-inch and about 10 to a mold will be found convenient for handling and also for counting if a considerable stock is made at any one time. The hole in the end of the mold makes it convenient to hang the same on the wall out of the way when not in use.

The openings left by the screws are

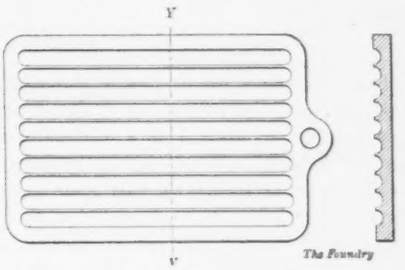


FIG. 12—SOLDER MOLD

filled with beeswax and are available when the pattern is to be shortened or lengthened, and thereby a second drilling is obviated. Small defects in the pattern may also be filled in the same way, but unless the cavities are small and deep the wax will fall out or will be knocked out when ramming the pattern. The melted wax is applied with a putty knife and after it has hardened, two or three thin coats of shellac are applied, each coat being sand-papered after the shellac has set. The pattern is then ready for the flask.

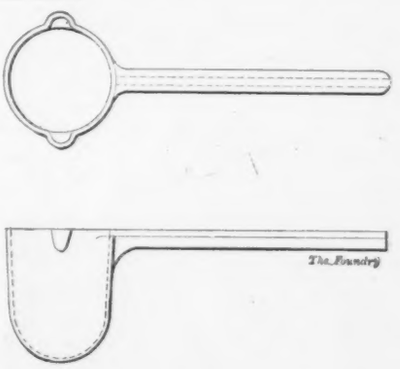


FIG. 13—LADLE FOR MELTING WHITE METAL AND SOLDER

The expense of making a lead pattern of this kind varies from $100 to $200, depending upon the style and size of the tub and whether or not the sheet lead has been previously used for another pat-

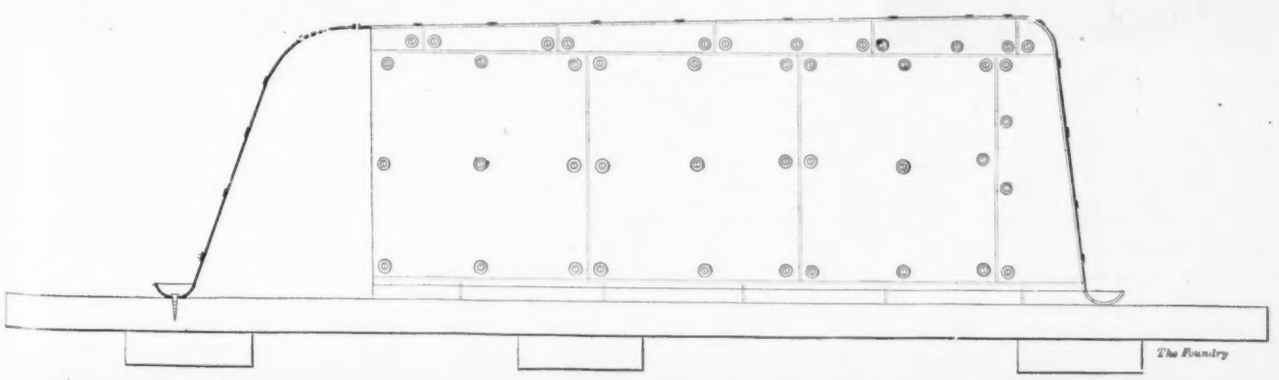


FIG. 11—METHOD OF APPLYING WHITE METAL CASTINGS AND SHEET LEAD TO THE FORM AND FOLLOW-BOARD

tern. The dimensions of a five-foot tub are measured over the rim and not inside of the body. The one exception to this is where an extra large rim is used and the body of another pattern has been appropriated.

Wood Pattern.

Some concerns use the form described together with the follow-board, but build a wood pattern instead of a lead pattern for the original. However, the majority of the manufacturers of cast iron sanitary ware prefer lead patterns for their tubs. For making the wood pattern a skillful patternmaker is required, and as the body of the pattern is only 5-16-inch thick, and frequently only ¼-inch it is at best very frail. With such a wide surface to be glued together the joints do not hold and dovetailed pieces of wood must be used to hold the larger sections together. Even when these precautions are taken the pattern frequently warps out of shape when bedded in the damp sand. The curved sections being very thin are fitted only with difficulty around the curved ends and corners, and thin pieces of paper must be put over the form to prevent the glue from sticking the pattern to the form. Furthermore, the pattern can only be reduced with difficulty from 5½ to five feet or lengthened as desired, and even the best wood pattern can usually be used in the sand only three or four times as the pattern can be easily split by a few hard taps with a mallet. The author, however, has made wood patterns for hurry

FIG. 1—MOTTLED IRON CAST IN A CHILL

orders and as they are practically duplicates of the tubs shown in the previous article and have so little to commend them, no illustrations of the wood patterns are shown.

The core box for valve cores, described in the March, 1909, issue of THE FOUNDRY, is the subject of a patent No. 904,697, granted to Emil B. Horne, Haydenville, Mass.

THE INFLUENCE OF GASES ON THE STRUCTURE OF CAST IRON.

At a recent meeting of the Staffordshire Iron and Steel Institute, a paper was read by J. E. Fletcher on the "Influence of Gases on the Structure of Cast Iron and Steel." The author is a practical metallurgist in complete control of a large plant comprising coal mines, blast furnaces, forges and mills in the famous old iron making district of Dudley.

In his remarks on cast iron he said: "Every observant foundryman knows

FIG. 2—WHITE IRON CAST IN A CHILL

that gases play an important part in the structure of cast iron, and that unless sufficiently large feeding heads and risers are placed near the heaviest sections of a casting, blow holes, cavities, and pipes are inevitable. The office of the feeding head is to allow the gases to escape from the molten interior of a casting, and to give liquid iron a chance to replace the space recently occupied by the gases. When a portion of a casting is chilled, the gases liberated when the iron (ferrite) crystals are formed, are driven at great speed through the eutectic or mother liquor surrounding such crystals and should the silicon be low and the manganese high, the crystals of cementite will arrange themselves at right angles to the chilled surface. This crystal arrangement, which is to be observed in every chilled casting, seems to follow the paths of gas escape. The fracture of a mottled iron ingot, cast in a chill, shows clearly the gas paths, and the position of the pipe, Fig. 1. A similarly cast ingot of white iron, Fig. 2, when fractured reveals the gas paths and zones of weakness, and some imprisoned gas bubbles, or blow holes. The microphotograph, Fig. 3, which is that of a white iron, goes to prove that the crystalline structure of a cast ingot is determined by the direction of the gas paths.

"An intelligent consideration of the gas paths, when dealing with the casting of any pattern, however complicated, will show where heads, risers, and runners should be placed for the best results. As in the case of steel, silicon and manganese play an important part in connection with the escape of gases during solidification. An iron with 3.5 per cent carbon and 96.5 per cent iron, when fractured, is white, whether cast in a chill or in sand. Under the microscope small gas cavities appear in the entectic portion, which was last to solidify.

"If this iron is remelted, and 2.5 to 3 per cent silicon added, the resulting fracture is gray. Gas cavities are absent, and in the center of the casting, that last to solidify, graphite is found in coarse flakes. This graphite is swept into its place by the escaping gases, and, as might be expected, the higher the casting temperature, and the slower the cooling, the higher is the graphitic content.

"If this gray iron is again remelted and 4.5 to 5.0 per cent manganese added the resulting iron is white. Under the microscope, it shows plainly the powerful influence of the mangan-

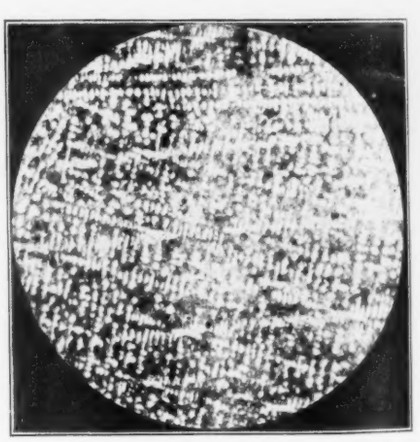


FIG. 3—MICRO-STRUCTURE OF WHITE IRON

ese, and its freedom from gas cavities, even under high powers of magnification, is unmistakable. Silicon appears to promote slow cooling, while manganese has the opposite effect. In other words, silicon, by keeping liquid the eutectic or mother liquor, in which the crystals are growing, enables the gases to escape freely from between the fir tree like branches of the crystals."

A MODERN PACIFIC COAST FOUNDRY

Description of the new casting plant of the Independent Foundry Company, Portland, Oregon --- Cost system

BY H. COLE ESTEP

PACIFIC coast foundries have been rather severely criticized on account of their lack of progressiveness and their slowness to fully appreciate the importance of the revolution in foundry practice that modern machinery and appliances are producing. The criticism is not without foundation but is rapidly losing force. One by one the plants on the Pacific slope are falling into line. One of the best examples of a modern foundry operated on scientific lines is the new plant of the Independent Foundry Co., at Portland, Ore.

This shop was originally built at the close of 1906 by the Willamette Iron & Steel Works, Portland. It was erected in the record breaking time of 60 days. In the spring of 1908 the property was purchased by the Independent Foundry Co.

Building.

The main foundry building is a slow burning frame structure, 100 x 208 feet; it is well lighted with windows, 6 x 9 feet, and a continuous skylight along the apex of the roof; the building is unusually high and roomy inside. The beneficial effects of the extra height are very apparent in the molding room; the high walls permit a top row of windows above those mentioned, which results in perfect and uniform lighting of the molding floor. The high roof allows the gases and dust incident to pouring off to rise out of the way, keeping the room wholesome and comfortable at all times. These very evident advantages, resulting from the extra height, should serve as an object lesson to those who are inclined to construct low buildings for the sake of saving a few dollars in first cost.

Equipment.

There are two cupolas, centrally located; one is a 54-inch Colliau and the other is a 66-inch Whiting; both are of standard design and construction.

Two large core ovens, each 14x24 feet, are situated adjacent to the cupolas. These ovens are fitted with special wide gage trucks fitted with core racks. A smaller oven nearby is used for small or special work.

Transportation within the foundry is effected by a 20-ton electric traveling crane having a 50-foot span and a 208-foot runway. Just outside the foundry door is a 20-ton jib crane which can take castings from the traveling crane and load them onto cars without re-handling. Post and jib cranes have been installed at convenient points on the molding floor. These cranes facilitate greatly the handling of light work and save much time that would otherwise be wasted in waiting for the main crane.

The charging floor is 16 x 36 feet. The coke and iron are brought up to its level in buggies which are hauled up an incline plane from the storage yard by means of an electric hoist. The auxiliary machinery, including two 48 x 60-inch rattlers, a 30-horsepower air compressor, two cupola blowers and the charging floor hoist, is all electric driven. The plant is lighted by gas and electric arc lamps, supplemented by incandescent bulbs where necessary.

Storage.

The arrangement of the coke, iron and pattern storage is a feature worthy of special commendation. Too many Pacific coast plants are very negligent in these particulars. The arrangement at this plant is about as effective and economical as could be devised. The iron is stored in the open air on a plot of ground 100 feet square, near the charging floor incline. The pig is piled neatly while the scrap is piled in separate bins according to quality and is not all dumped together in a miscellaneous heap as is often done. The pig and scrap breaker, operated by a compressed air hoist, is situated in the center of the storage yard. The yard is served by a 10-ton boom derrick which can pick up material from any point and load it directly into the charging floor buggies.

The coke is stored in a separate build-

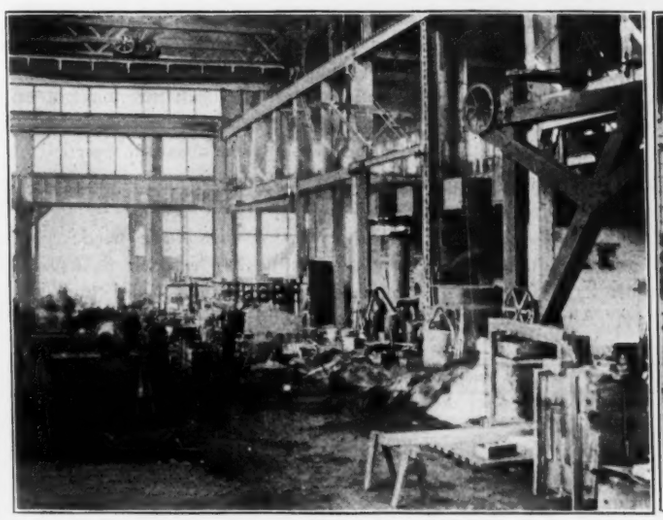


FIG. 1—GENERAL VIEW OF FOUNDRY FLOOR LOOKING EAST

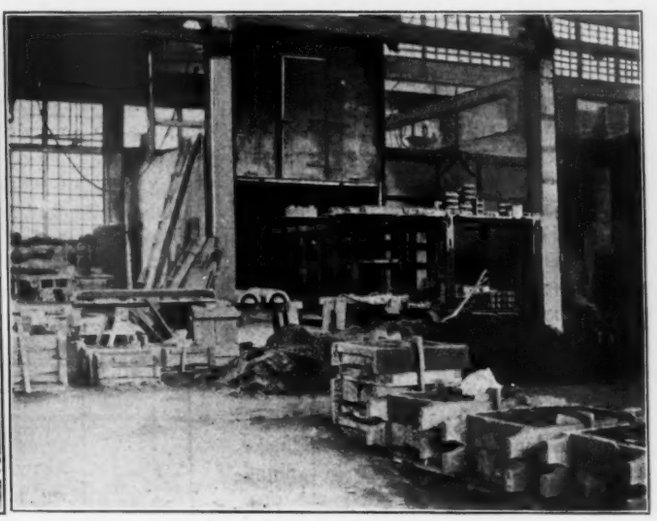


FIG. 2—CORE OVENS AND PORTION OF MOLDING FLOOR

ing 40 x 70 feet, situated directly back of the main building. The flasks are piled and sorted according to size and condition. The heavy flasks as well as those

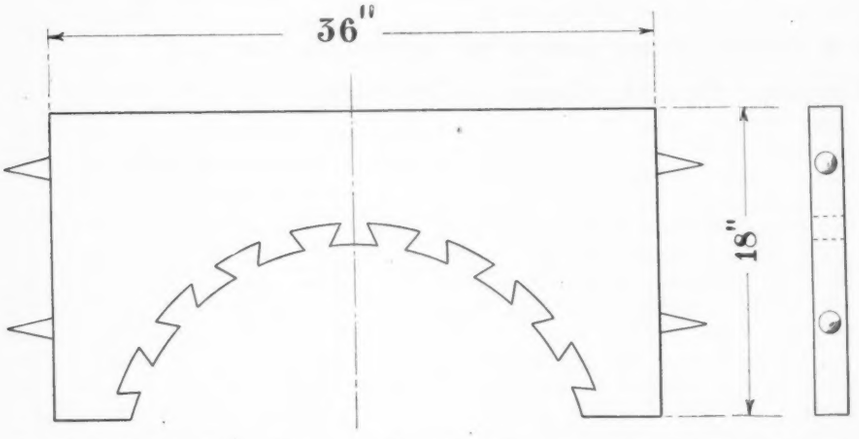


FIG. 3—CAST IRON FLASK BAR WITH CAST IRON POINTS FOR FASTENING THE BAR TO THE SIDES OF THE FLASK

in good condition are placed at the most accessible points.

A large stock of standard patterns is carried and these, together with the customers' patterns, are stored in a three-story, fire proof building adjacent to the rear of the main foundry. The pattern storage building has its three floors arranged in galleries around a central well, thus making each floor easily accessible. The patterns are stored on shelves and racks in the usual manner. On each pattern is printed the pattern number, the name of the firm owning the pattern and the shelf number and location. These latter numbers are arranged in three parts thus: 2-H-1, which in this instance means second floor, rack H, shelf No. 1.

Foundry Practice.

The foundry employs 60 men, 25 of whom are molders; it has a daily capacity of 40 tons and is prepared to make single castings up to 20 tons in weight. Three distinct lines of work are produced, namely: gray iron, special chilled and semi-steel castings. A specialty is made of the semi-steel mixtures which are in favor on the west coast. These are made by charging from 20 to 30 per cent of mild steel scrap which decreases the graphitic carbon in the castings and produces a metal that will stand 30,000 pounds per square inch in tension and a transverse stress of 3,000 pounds per square inch. Unusual care is necessary in making up the semi-steel mixtures, specially because the quality of scrap obtainable on the Pacific coast varies widely. It is not possible to obtain carefully graded material in the west, and consequently each charge must be treated practically as an individual problem. Test bars are cast with each heat and are subsequently analysed for defects in the mixtures.

European coke, imported from Great Britain and Germany in sailing ships is used, mixed with coke from the local ovens and from the Connellsville district.

This foundry was among the first on the coast to introduce molding machines. Included in the molding machine equipment is an Adams squeezer, a Delano pulley machine and a Herman jarring machine. The problem of applying machine molding to Pacific coast foundries is somewhat difficult on account of the great variety of work turned out by each plant. Far western plants are only commencing to specialize and each shop is still doing a large amount of jobbing. The variety of work is so great that it is difficult to get accurate data on the capacity of the various types of machines. A machine to be suitable for service in the west must have adaptability as its strong feature. Ability to turn out vast quantities of duplicate work is not required at present. Ability to produce almost any work and perhaps never the same piece twice at an economical figure is essential. Machines that require special patterns and extra work for adapting the patterns to the machines are not well suited to the requirements of Pacific coast shops. At the Independent foundry the jarring machine has molded hoisting engine drums in 20 to 30 minutes that by hand labor required four hours and 120 common grate bars were molded in a day, two bars in a flask. The squeezer machine has also been found successful on light work and on some lines has increased the output 50 per cent. The pulley machines are not economical unless operated continuously, a condition that obtains in only a few Pacific coast shops.

Labor System.

At the Independent foundry the laborers are managed on the group system which reduces to a minimum the number of high priced, skilled molders required. Under this system each skilled molder has a group of from two to four helpers working with him, for whom he is responsible. This system has peculiar advantages in the west on account of the high price of skilled molders and the local labor conditions, which make it advisable to keep the number of molders at the lowest possible figure.

Flasks.

Four types of flasks are used: common wooden flasks; wooden flasks with iron bars; combination wood and iron flasks; and solid iron flasks. Except for

Date	MELT REPORT				Date	RETURNS FROM MELT						CASTINGS RETURNED		
Iron No.	Weight	S		Cost	Per	Finish	Lost	Molding Labor	M. Lab. per lb.	Pounds Finished Cast'gs per Molder	From	Weight	Remarks
Waste													
Steel													
Scrap													
Gates													
Cup. Labor													
Total					Total						Total		
Return					Total Castings		LABOR		%	PAY ROLL	Labor per Cwt. Finish Castings		Supplies
Loss					Gates		Molders						
Excess					Over		Coremakers Helpers						
%					Waste		Cupola Help.						
					Total Return		Total						
Coke Forg.					% Finish		Fnd. Ex. Molder						
Coke Dom.					% Lost		" Help						
Total Coke					% Total Castings		Total						
Iron per lb. Coke					Fired Up per Day				Cost Fin. Cast Iron				
Cost Return Spout					" " " lb. Finished Cast				" Molding				
" Total Cast at Spout									" Coremaker and Help				
" Finish Cast at Spout									Total Cost per lb.				

The Foundry

FIG. 4—FOUNDRY REPORT SHEET

an occasional large casting which will not be duplicated, the plain wooden flasks are being gradually discarded; even for the occasional large casting the combination flasks are proving highly satisfactory. The wooden flask with iron bars is a great advance over the old plain wooden box with wood bars and is used extensively in this shop. These iron flask bars, one of which is shown in Fig. 3, are not the common, cheap sheet iron bars that have so many times demonstrated their inefficiency. They are cast iron, ⅜ to ½-inch thick, specially made for their purpose. The dove-tail notches hold the sand firmly and decrease the number of gaggers necessary. These bars are indestructible and efficient. A foundryman once using them would never turn to the old, unsatisfactory wooden bars.

The combination wood and iron flasks, having wooden sides and iron ends, are peculiar on the coast to this foundry and are an unusually adaptable article. As is shown in Fig. 5, the ends of these flasks are of iron cast in an I-beam form while the sides are wooden boards. The whole is held together by through bolts on both sides, which lie snug against the wooden sides of the flasks. The ends of the boards are fitted to the iron by a bevel joint which is tight. Iron cross bars, such as have been described above, are used; only the sides of the combination flasks are wood. The iron ends are carried in stock sizes and the flasks can be made up quickly to any desired length. This type of flask has proven itself in this shop to be one of the most economical styles that could be used for general jobbing work.

Cost System.

Each order as it is received is entered and given a number. Tally cards, 4x8-inches, made of heavy manila card board, numbered serially and with the consecutive order numbers printed on the face are issued for each order and go into the shop. The tally card bears the date and five columns headed as follows, from left to right: "No. req'd," "Description," "Pattern No.," "Foundry Sheet" and "Drawing No." These headings are all self-explanatory except "Foundry Sheet." This refers to a special sheet issued for each order, when necessary, which contains instructions and a list of the cores and the loose parts of the patterns. The tally card goes with the job until it is delivered. Each molder is provided with a slate on which he records the molding time of the various jobs on which he is engaged. Transcripts of these are made twice daily by the timekeeper. In the office, the time and other items of expense for each order are grouped on a single sheet, 9½ x 12 inches, which forms a record of the cost of each order. Both sides of the sheet are used, the obverse containing the date, order number, tally card number, a brief description of the job, the customer's name, the date finished, the molding labor (segregated) and the number and weight of the good and lost castings in the order. The reverse side of this sheet contains the pattern labor and the summary, including the proper proportion of fixed expense, which is apportioned according to the molding time and the weight of castings included in the order. It was found that to charge fixed expense simply in proportion to the labor cost or to the weight of castings was incorrect and that a combination of these two

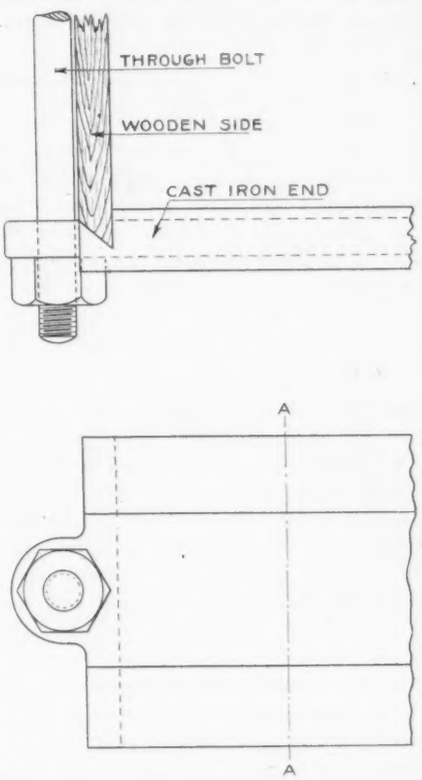


FIG. 5—PLAN AND ELEVATION OF A WOOD AND IRON FLASK

items must be considered in properly apportioning this item of expense among the various jobs.

A report sheet, Fig. 4, containing a summary of the day's melt and labor costs is made out for each day and filed in a book kept for the purpose. These reports show at a glance the cost of each heat and the returns from the day's work. Keeping a proper cost account for a jobbing shop such as is under consideration, is a very complicated problem and one which has by no means reached its final solution. The foregoing shows in a general way along what lines the problem is being attacked by one progressive concern in the far west.

The officers of the Independent Foundry Co. are: C. E. Grella, president and manager; W. B. Mackay, vice president; and W. L. Brewster, secretary.

MELTING IRON FOR SASH WEIGHTS.

BY W. J. KEEP

Question:—Can you give us detailed information regarding the melting of wrought iron, scrap and tin for sash weights? While we are aware of the fact that this material is melted successfully we have thus far been unable to get good results. While our material is apparently at a white heat when tapped out of the cupola, before it is poured into the molds it is nearly set and the molds cannot be filled. Since making these experiments we have learned that there is petroleum coke used in addition to regular foundry coke in our locality and that limestone is used as a flux. We desire to melt from one to two tons of this material in addition to our regular heat. Can you advise us what proportions of regular coke, petroleum coke and limestone to use, as well as whether a blast or 10 or 12 ounces is proper in a cupola lined to 36 inches?

Answer:—You should pound or press the scrap tin into a mold of some kind, making it into balls about six inches in diameter or less. Cut the steel scrap as small as broken pig iron and use enough of the latter or scrap so that the molten metal will remain fluid long enough to fill the molds. The higher the silicon in the scrap the less of the latter you will have to use. We would suggest that you try stove plate scrap and use about 40 pounds of limestone for every ton of iron. I would charge the tin and steel scrap first on a heavy bed of coke and the limestone last, and put the charge into the cupola before the last regular charge is any considerable distance below the charging door so that it will be white hot before it reaches the melting point. Would suggest that you use ordinary coke, as petroleum coke is very expensive and you will get better results by putting the extra money into pig iron or scrap. Petroleum coke costs twice as much as ordinary coke. It gives you a very high temperature but unless you are near an oil refinery it is not practical to use it. A very small piece of pure aluminum in your ladle will enable you to fill your molds easily, as by its use you will reduce the percentage of pig iron. One concern crushes tin cans into balls in an old stone crusher. Your blast pressure is sufficiently high.

The Harrison Supply Co., Boston, is distributing to the trade a handsome calendar, together with a well written discussion of "Quality vs. Low Prices," in reference to its chilled steel shot for sand blast purposes.

REVERSIBLE PATTERN PLATE PROCESS

A new and simple method of producing these plates for foundry use---Theory of the French method

BY GEORGE MUNTZ

THE production of pattern plates is the nightmare of every foundryman operating molding machines. However, these plates can be easily made and at a low cost. Numerous methods have been developed by foundrymen all over the world, but as a rule these are carefully guarded. It is not the writer's intention to pass in review all of the existing or obsolete processes of making pattern plates, but rather to give his experience and the result of his investigations along this line.

The expression "half pattern" will be frequently used in this article. It is not intended, however, to convey the idea that the pattern must be

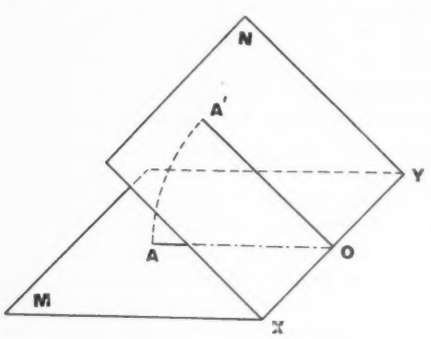


FIG. 1—SHEET OF PAPER FOLDED

absolutely symmetrical or even a split pattern. The pattern is supposed to be divided into two parts by a parting line and the part bedded in the drag will be termed the drag part, while that printed in the cope will be termed the cope part. The drag half of a pattern is usually different from the cope, and therefore when we speak of a half pattern we understand as a rule two different sections, and it should be borne in mind that no matter how different the two parts are they can always be arranged to form a reversible pattern plate. However, whether the pattern plate will be practical or not for the purpose for which it is intended must be left to the judgment of the foundryman. A half pattern must then be considered the drag or cope part of the pattern no matter how different they may be in size and shape.

A reversible pattern plate does not have one-half of the pattern on one side of the plate and the other half on the other, but has the two half patterns mounted on one side of the pattern plate only in such a manner that cope and drag of a mold will be rammed on the same pattern plate, and will, therefore, be identical with the exception of the sprue, which will have to be provided for in the cope. In other words, the reversible pattern plate, although there is only one pattern on the plate, produces two castings in the mold because, in closing, the corresponding halves of the mold, the patterns are brought on top of each other. It is therefore apparent that in a mold made on a reversible pattern plate, one casting will have for its drag the cope part of the other, and for this reason there is a limitation in the use of reversible pattern plates, namely, when a casting is to be poured a certain way. This is true when clean surfaces for finishing have to be obtained.

French foundrymen have been pioneers in the production of cheap reversible pattern plates. The theory

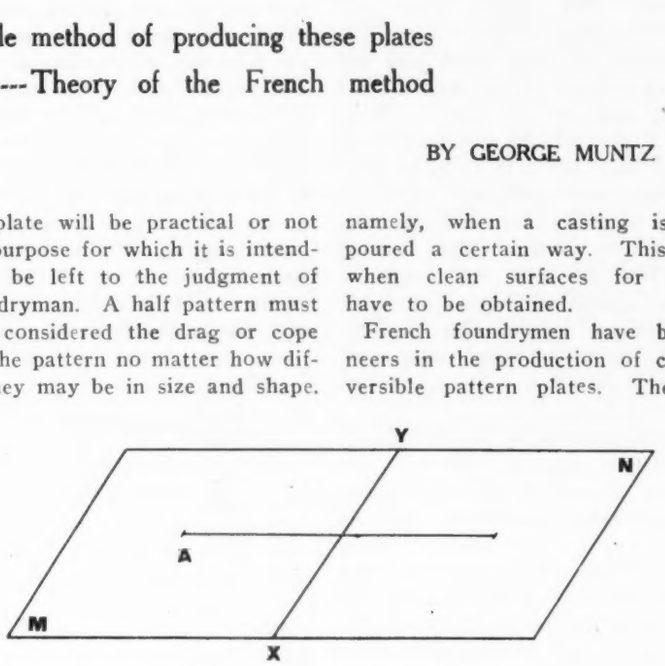


FIG. 2—SHEET OF PAPER OPENED

of symmetry underlies their process, and before considering the making of these plates further it might be well to briefly refer to this idea. If we take a sheet of paper, Fig. 1, and fold it after marking a point A on half of the sheet M, there will be a point A′ on the half of the sheet N, which will coincide with A. If we mark this point, open the sheet and draw the line A, Fig. 2, this line will be perpendicular to the folding line XY, and the ends of the line A will be equally distant from XY. Therefore, the two points at the ends of the line A are said

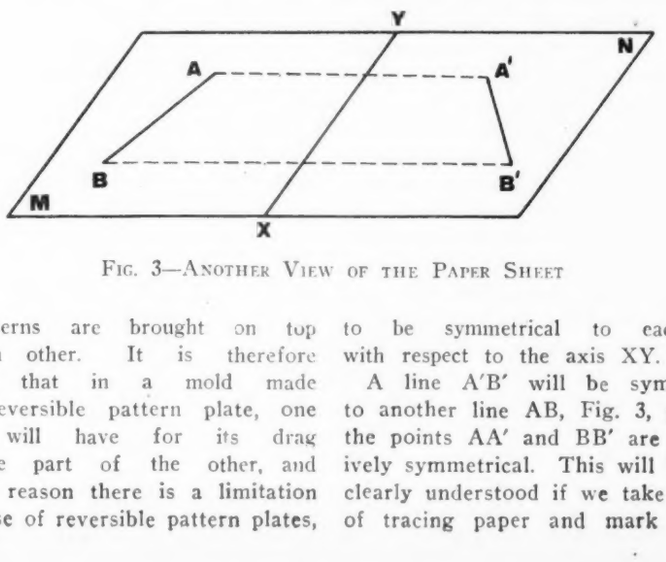


FIG. 3—ANOTHER VIEW OF THE PAPER SHEET

to be symmetrical to each other with respect to the axis XY.

A line A′B′ will be symmetrical to another line AB, Fig. 3, provided the points AA′ and BB′ are respectively symmetrical. This will be more clearly understood if we take a sheet of tracing paper and mark off the

four points AA′, BB′ as aa′ and bb′ and reverse the same as shown in Fig. 4. On another sheet of paper the same points should be indicated as dd′ and BB′. If we desire to place the second sheet on top of the first without reversing it, and in such a manner that the eight points, a and d′, b and B′, A′ and d, and b′ and B will coincide, we will have to swing it 180 degrees around the vertical axis TV. This is the theory of the French reversible pattern plate method. The first sheet of paper represents the pattern plate, the first sheet of tracing paper the drag of the mold and the next the cope. The drag is first placed on top of the pattern plate, rammed up and rolled over. The second flask is then placed on top of the same pattern plate,

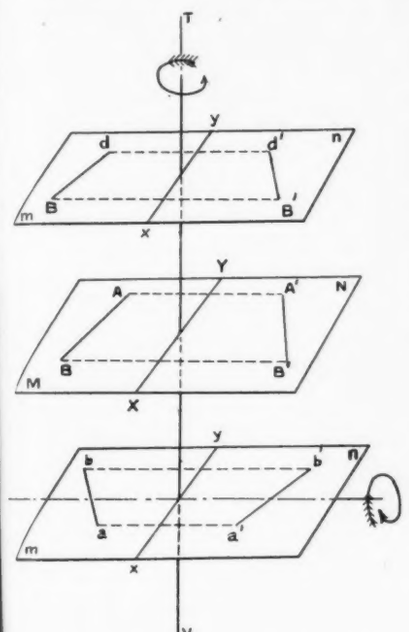


FIG. 4—SHEETS OF PAPER PROVIDED WITH A COMMON AXIS

the sand rammed and then placed on top of the first flask after being swung 180 degrees.

Thus far we have dealt only with lines, and this has been done to show that in reversible pattern plate making the patterns themselves must be absolutely forgotten and only the parting lines should be considered. Therefore, if two patterns are set side by side so that their parting lines will be symmetrical with respect to a certain axis, they will form a reversible pattern plate.

French Device.

The French apparatus used for making reversible pattern plates follows the folded paper theory closely. Two half circular flasks can be placed side by side so that the pins PP′ will be symmetrical to the straight side XY of the flasks shown in Fig. 6. These flasks are used for making a mold from a pattern from which a

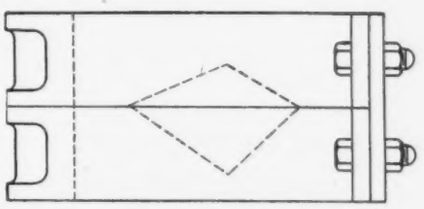


FIG. 5—FLASKS, HALF CIRCLES, CLOSED

pattern plate is desired. When the mold is open and the two parts are bolted together, the two prints of the half patterns have their parting lines symmetrical with respect to the axis XY, and therefore form the mold of a reversible pattern plate. If a frame F is set on top of this mold and plaster, cement or white metal poured in, a reversible pattern plate is made. A great many additional details naturally are involved in this operation, including the shaving off of the sand to give the plate a certain thickness, but this work is encountered daily in the foundry and an explanation can be omitted, inasmuch as the foundryman interested will work out these problems himself. The straight parts of the flask are removable and are taken off when the two half circles are bolted together. The two planes of sand thus determined form the plane of symmetry of the pattern plate when they coincide.

Difficulties Experienced.

Occasionally this method fails, but this is due only to mechanical imperfections of the apparatus. Every foundryman can appreciate that the device is somewhat difficult to build accurately, and furthermore, it requires an experienced and careful molder to apply the method successfully. If sand breaks off and falls between the two flasks before bolting them together, the two pins will no longer be symmetrical, and the castings will vary as shown in Figs. 7 and 8. If a tool should strike one of the edges of the flasks, Fig. 9, it will produce two projecting lips of metal which, if they protrude only 1/64-inch will produce a variation of 3/32-inch at the periphery of a 24-inch flask. This is considerable in a reversible pattern plate, as every variation must be multiplied by two, owing to the fact that the cope must be swung 180 degrees before closing the mold. The variation is the multiplication of the ratio of OE to OF, Fig. 8.

In addition to other difficulties this method involves the swinging of the cope 180 degrees to close the mold. The variations that occur must be multiplied by two and this is a frequent cause of errors and failure of pattern plates. Furthermore, all appliances for foundry use should be made more or less foolproof.

New Process.

The method* we have devised for making pattern plates is based on the theory of symmetry, but in rolling over the drag as shown in Fig. 4, it is revolved about the axis XY, which in practice, corresponds to placing the pins of the pattern plate

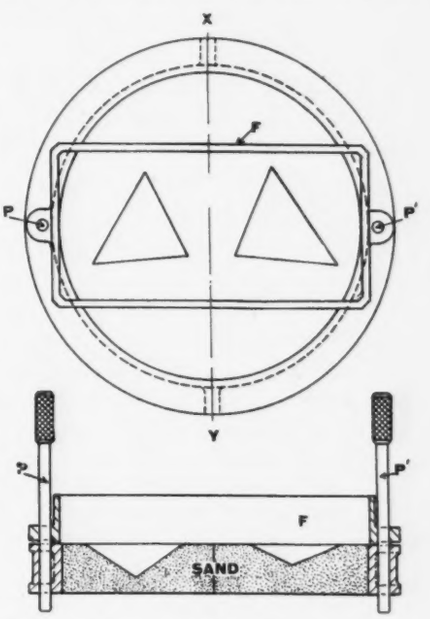


FIG. 6—PLAN AND SECTIONAL VIEWS OF TWO, HALF CIRCULAR FLASKS, SET SIDE BY SIDE

on this axis. It can readily be appreciated that if the parting lines of the two half patterns are symmetrical with respect to XY, and if the pins on the pattern plate will have for a center line the line XY, any mold made on such a reversible pattern plate can be closed without swinging the cope 180 degrees. By the use of two ordinary foundry flasks reversible pattern plates can easily be made. The two flasks A and B are shown in Fig. 10. The mold is rammed so as to utilize only half of flask A, shown at M. This section of the flask occupies exactly one-half of the total flask area and is divided off by a suitable partition. The mold is then opened carefully and the two parts

*Patent applied for.

placed on the table. A frame F, constructed similar to the flasks, either slightly lower or higher, as required, is set on top of flask B, Fig. 11, and plaster, cement or white metal

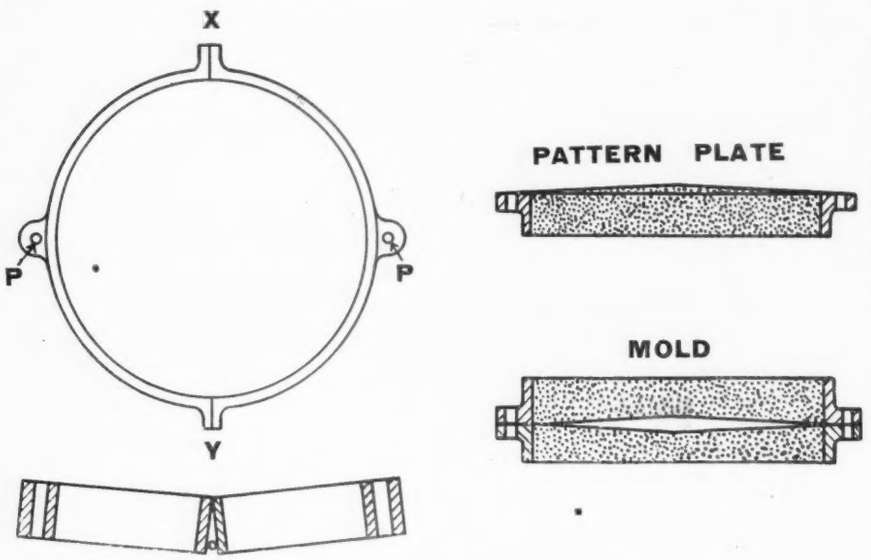


FIG. 7—THE EFFECT OF PARTICLES OF SAND BETWEEN THE BOTTOM EDGES OF THE FLASKS; THE THICKNESS OF THE CASTING IS INCREASED AND A HEAVY FIN RESULTS

is poured into section M'. In each of the preceding operations we have cast one-half of the reversible pattern plate. The plate is then finished and the chances of variation are confined to the drilling of the two holes for the flask pins which can be accurately done. This method has been successfully used with ordinary foundry flasks as well as snap flasks.

A special device used for this work which is a part of the apparatus for making pattern plates in general has been devised. The flasks are built as shown in Fig. 13, and in Fig. 14 the two flasks have been placed on top of each other and contain the pattern or patterns from which the pattern plate is to be made. A partition C, Fig. 14, divides the flask A in such a manner that the line XY, Fig. 17, will be the axis of symmetry of the pattern plate. After the mold has been opened a frame is placed over flask B. If holes have not been drilled in this frame this operation can be obviated by casting white metal bushings around the pins. After removing partition C from flask A and setting the same in the frame F, the first half of the plate is cast as shown in Fig. 15. This partition is then removed and the frame F is set on top of flask A and the second half of the plate is cast. The reason that the flask A is larger than flask B is to provide a space for the half of the pattern plate which has already been cast. This method will be appreciated in foundries where gates of patterns are used. Pattern plates can be obtained by this method having a perfect alignment of the patterns on the plate.

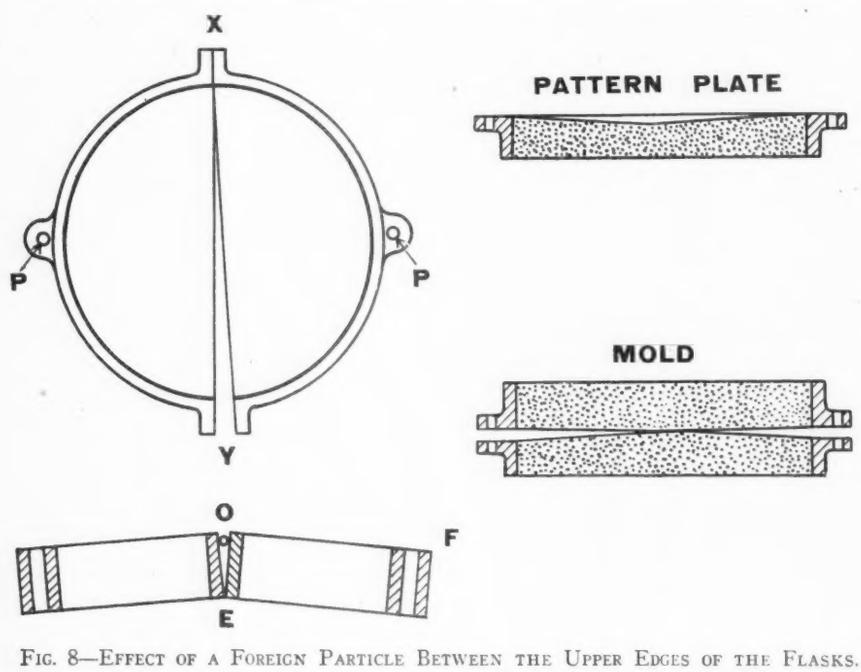


FIG. 8—EFFECT OF A FOREIGN PARTICLE BETWEEN THE UPPER EDGES OF THE FLASKS. THE SAND WILL BE BROKEN DOWN WHEN THE MOLD IS CLOSED

CRUCIBLES, THEIR CARE AND USE.

"Crucibles, their Care and Use," is the subject of an able and comprehensive discussion of the manufacture and care of these melting pots, published by the

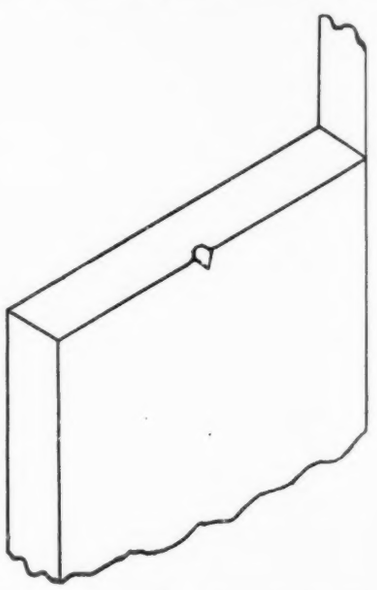


FIG. 9—EDGE OF A METAL FLASK DAMAGED BY A TOOL

Joseph Dixon Crucible Co., Jersey City, from which the following extracts are made:—

In making crucibles there is added to the graphite sufficient clay to furnish the necessary binding qualities which graphite lacks, and fire-sand to give the crucible openness of grain, thus rendering it able to withstand sudden changes in temperature.

A well proportioned crucible is made thicker at the bottom, and the sides gradually decrease in thickness toward the top. This formation naturally offers the maximum of resisting power. Crucibles with thinner walls will, of course, conduct heat more rapidly, but are liable earlier to succumb to the strain of heating and handling.

As to the color of finished crucibles, it need only be said that while some are

darker and some lighter in shade, there is absolutely no difference in quality on account of this difference in color.

The difference in color is the result of an oxidizing condition in the kiln at the time of burning.

To economize space, crucibles are "nested" in the kiln. By "nested" we mean that a smaller one is placed inside a larger one. Even though the outer one does not come in contact with the flame, some air will creep in, due to the expansion and contraction of the kiln

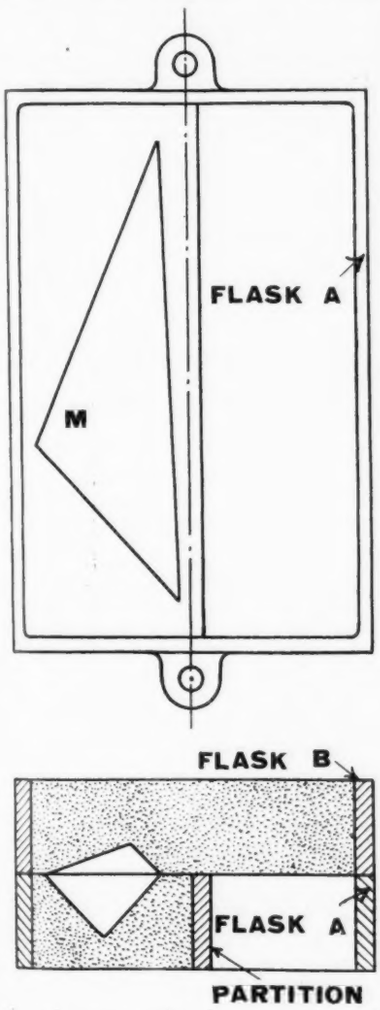


FIG. 10—MOLD RAMMED IN HALF OF THE FLASK

walls, and at a certain degree of temperature this air finds its affinity in the carbon, and they both escape in the form of carbonic acid gas—this changes the color of the crucible.

One source of trouble now and then reported, and most exasperating to the crucible maker, is what is known as "scalping" or flaking-off of a portion of the crucible. This is invariably caused by carelessness at the start.

When the crucible comes from the kiln it contains less than one-quarter of one per cent combined moisture. In this condition it is absolutely impossible to scalp it, but the moment it cools off it begins to absorb what is known as hygroscopic moisture or the moisture that is in the air, and once absorbed, it requires a temperature of not less than 250 degrees

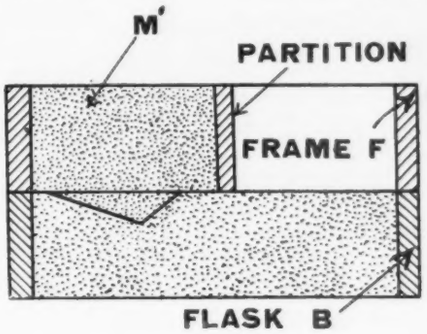


FIG. 11—FRAME SET ON TOP OF THE FLASK

Fahr. to dispel this moisture. It is also essential that the crucible be kept to this temperature to prevent its absorbing the moisture again.

The user will write to the manufacturer and say: "I kept these crucibles in a hot place." Maybe he did, but not hot enough. He may have had them in a temperature of 150 degrees, but 150 degrees is not high enough to prevent this moisture going into the walls of the crucible, and, while on a very small pot the chances are that no evil results would follow with 150 degrees, it is emphatically true that a large crucible, with its thicker walls, absolutely needs a higher annealing temperature than 150 degrees Fahr. This is due to the fact that the higher heat in the furnace is so sudden that the moisture cannot escape the walls. It quickly becomes steam and expands—pop goes the crucible and you have a miniature steam explosion.

It is, therefore, very important that the crucible should be properly annealed in a temperature of at least 250 degrees Fahr., before using.

Concerning a proper method of annealing, there can be no fixed rule as conditions differ, but it is the general practice to anneal on the top of the fur-

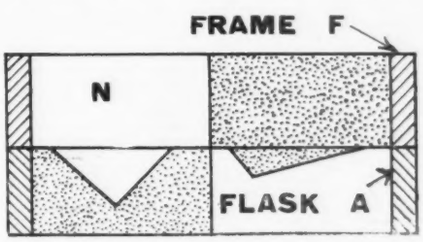


FIG. 12—MOLD RAMMED IN OTHER HALF OF FLASK

nace, although some foundries are equipped with a furnace used exclusively for this annealing, and it is an interesting fact that such foundries never have "scalped" crucibles.

Whether annealing in a special furnace or on top of the crucible furnace, there are four points that must be observed:

First: The temperature must go above 250 degrees Fahr.

Second: This temperature should be reached gradually.

Third: This temperature must be held a sufficient time to allow the moisture to thoroughly disappear.

Fourth: The crucible must go in the crucible furnace with a temperature above 250 degrees Fahr.

For example, with a No. 200 crucible it should take at least ten hours to bring it up to this degree. It should "soak" in the heat fully ten hours and then be charged and go in the furnace at about this heat.

Some foundries practice the first, second and third rules perfectly and "fall down" entirely on the fourth by hurriedly

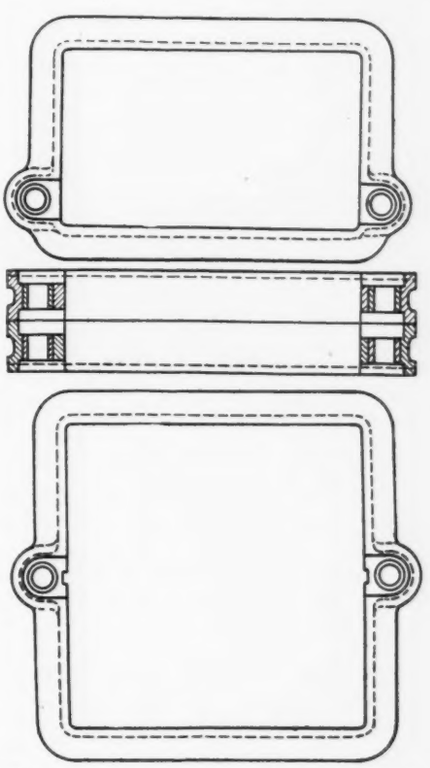


FIG. 13—PLAN AND SECTIONAL VIEWS OF NEW FLASK.

and carelessly taking the crucible from the furnace and placing it on damp sand or a cold furnace floor and allowing it to stand there indefinitely before charging.

A failure to comply with this fourth rule counteracts all that the other three have accomplished and the crucible maker may be informed that his pots are "no good."

It is a mistake to think that after the first three rules are complied with the crucible has had its annealing and is impervious to moisture, for, if allowed to cool below 250 degrees Fahr. it will take

up moisture a second time just as readily as the first time.

Another defect the crucible manufacturer hears of is what are known as alligator cracks. Now and then a melter finds a crucible with fine cracks all over it, even before it is in the fire. Examination shows the outside covered with hair cracks resembling an alligator's skin. This is due to hot gases and the result of improper annealing.

A crucible is placed on top of the furnace, close to the furnace opening; the furnace lid has been carelessly placed, leaving an opening. Fresh fuel produces more or less gas. Hot gases are always moist, and these gases lick up along the side of the crucible—they moisten the wall—an oxidizing condition develops, and when the heat is sufficiently high the clay body expands and cracks, just the same as a mud pie will crack under the rays of the mid-day sun.

It is generally understood that crucibles improve with age, and this fact explains why it is that the large consumer has little or none of the trouble the small buyer has. One orders in large lots, stores them away and gives them time to "season," while the other does not order until his stock is out, then sends in a rush order, and the crucibles go from kiln to furnace.

It is perfectly obvious that he who buys crucibles in quantities, stores them where they will be kept dry and free from all possible moisture, handles them carefully and intelligently, will secure a far greater number of heats than will the man who buys only as he needs them and stores or handles his crucibles carelessly.

After a crucible has been properly annealed it will stand a great amount of rough usage, almost abuse, and the danger from moisture and changing temperature becomes less and less as the crucible grows older.

Unless the annealing is carefully done, however, hidden cracks, flaws or fissures may be present which, under strong heat, may cause pin holes and similar defects to make their appearance.

Pin holes are one of the chief difficulties that the user of crucibles meets. Crucibles do not usually show this defect until they have been in use for some time. It seems to require a number of heats to develop this defect.

Pin holes are usually discovered by metal dropping down into the furnace pit, and when the crucible is removed a stream of metal will be found trickling down its side.

Pin holes are probably small fissures developed either during the drying or the annealing of a crucible, and there seems to be no way of avoiding an occasional defect of this kind.

Another cause of the shortness of life of a graphite crucible is the improper fit and careless management of the tongs. This is proved beyond doubt by the fact that in a tilting furnace it is not unusual to obtain from fifty to sixty heats from a No. 200 crucible as against ten or fifteen in a coal or coke furnace where it is necessary to handle the crucible with tongs.

This is natural enough, as the one fear of the melter is that the crucible will slip from the tongs while he is lifting it and he therefore takes a good strong grip on it, in fact often driving the ring of the tongs down with a skimmer.

A hot crucible is, of course, plastic, and a strong grip with heavy tongs will squeeze it out of shape. One may think that when in this plastic state simply bending a crucible will not injure it, but you must remember that this is done again and again, bending the crucible into one shape and then back into its original shape. As a result cracks or fissures appear, and the tongs sometimes break pieces out of it. The shape of the crucible tongs is an important matter. The best tongs are those made with heart-shaped jaws, giving a broad gripping surface, thus enabling the melter to get a good firm hold on the crucible, at the same time distributing the pressure instead of concentrating it at one point.

The tongs which do not grip the crucible with the full pressure of a wide jaw must necessarily injure it. Tongs, shaped as stated, remove the pot much more easily than ordinary tongs, and they should be made so as to grip the crucible below the bilge, making a heavy squeeze unnecessary.

Sufficient time and special care should be exercised in placing the metal in a crucible. It is quite natural to hurry in putting ingots into a crucible in order that the cover of the furnace shall not be left off too long. It is more or less dangerous, however, to jam the ingots, so particular care should be taken to see that they be placed in the crucible loosely.

Graphite is an inert substance, and as graphite is the crucible's principal in-

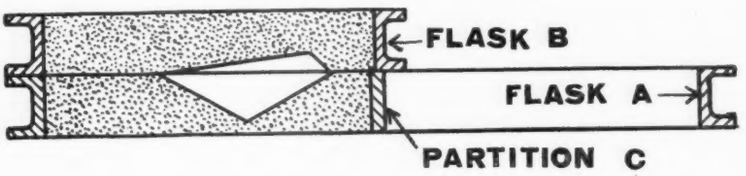


FIG. 14—FLASKS WITH PATTERNS FOR PATTERN PLATE

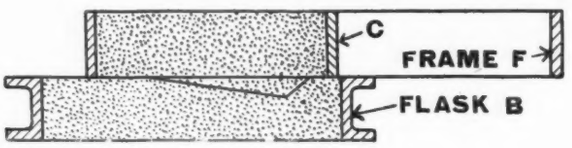


FIG. 15—METHOD OF CASTING FIRST HALF OF PATTERN PLATE

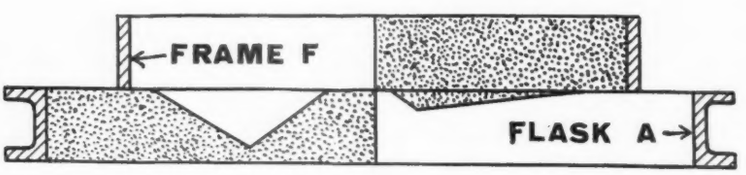


FIG. 16—ARRANGEMENT OF FLASK AND FRAME FOR CASTING THE SECOND HALF OF PATTERN PLATE

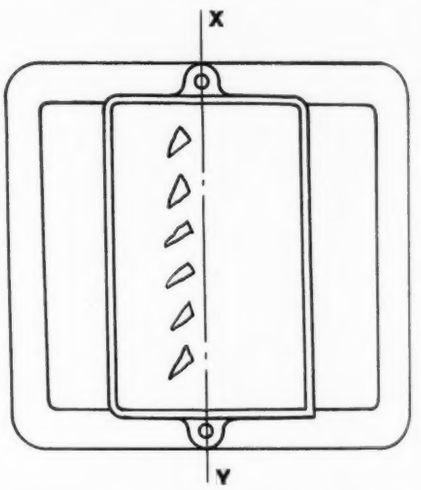


FIG. 17—THE AXIS OF SYMMETRY OF THE PATTERN PLATE IS SHOWN AT X Y

gredient, the only expansion possible to a crucible comes from its clay body, hence, if cold ingots are wedged in a crucible and jammed to fit tight, their expansion, which is much greater than the expansion of the crucible, will crack the latter before the melting point is reached.

Crucibles are often unwittingly injured by the furnace man in ramming his fires. As a usual thing, he will take a long steel bar and jam with all his strength into the hot fuel. He does this either to pack the fuel so that more may be added or to make room for the tongs prior to pouring. If, however, it is necessary for any reason to do this it should be done carefully and with judgment, for a crucible can be ruined very easily through careless ramming of the fuel. Sometimes a clinker or a hard piece of coal sticking to the crucible bottom will, when the crucible with its heavy weight of metal settles down, force a hole into the bottom. A good plan is to use a fire brick on which to rest the crucible. Sometimes the bottom of a worn-out crucible is cut off, turned upside down and used for this purpose.

Different kinds of fuel as well as different qualities of the same kind of fuel have great influence on the life of a crucible.

Up to the present time, anthracite coal and 72-hour coke have been the principal fuels. Of these two, pure coke is easier on the crucible. The reason for this is that the coke contains less gaseous matter, the gases having been liberated during the process of making the coke.

A GRAPHICAL METHOD OF OBTAINING METAL CONTRACTIONS.

By H. N. Tuttle

It sometimes happens that the patternmaker has to allow for several different contractions on the same pattern, for some of which he perhaps has no rule. The following case came under the writer's notice recently and is interesting on account of the number of unusual contractions required in the construction of the pattern. The pattern was for a steel pinion, about 12 inches in diameter and 5 inches face, with hubs and shrouds, making a total height of about 10 inches. Since the pattern was going into a steel foundry it was decided to make the body of aluminum. The shrouds were to be made of iron and the cope, hub and lugs (lugs not shown in the illustration) in wood, to lift off without anchoring.

It was found upon measuring several steel castings of a similar design that the contraction was 7/32-inch in diameter, but only 5/32 inch in height. This necessitated five unusual contraction allowances. Referring to Fig. 1, A, being aluminum, would require in the wood pattern 13/64 inch per foot allowance for the aluminum contraction, plus 7/32 inch for the

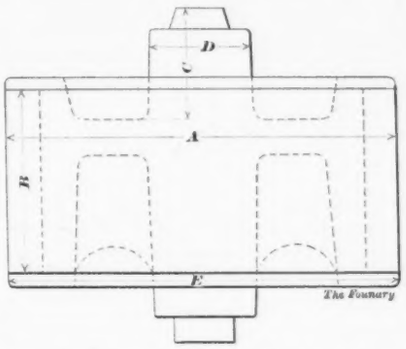


Fig. 1—Pattern for a Steel Pinion

wheel, B, because of the lesser contraction of steel in this direction, as noted above, would require 13/64 inch plus 5/32 inch, C being made of wood would require 5/32 inch and D, 7/32 inch, while E, being made in iron, would require 7/32 plus 1/10 inch. It was necessary to make the pattern as accurate as possible and the following graphical method was decided to be the most feasible solution of the difficulty:

The line A-C, Fig. 2, was drawn, marking off A-B which equals 12 inches, B-D was measured off and equaled 5/32 inch. From A as a center, arc D-H was struck, intersecting B-M, which is a perpendicular erected at B, at point H. A-H was then

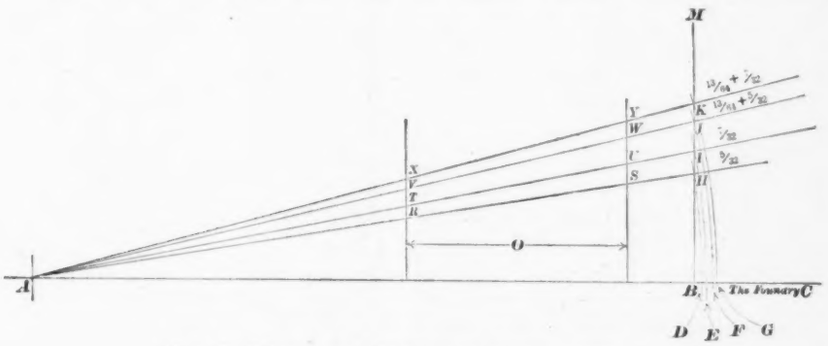


Fig. 2—Method of Obtaining Contraction

12 5/32 inches long. In like manner, B-E equals 7/32 inch and was struck up to point I; B-F equals 13/64 inch plus 5/32 inch and was struck up to J; B-G equals 13/64 inch plus 7/32 inch and was struck up to K. The 7/32 inch plus 1/10 inch contraction is omitted for sake of clearness. H, I, J and K were each connected to A by straight lines.

The layout of the pattern was then made upon line A-C, anywhere to the right of A, and with the common rule. From these measurements were erected perpendiculars intersecting the diagonal contraction lines. All measurements which are to have 5/32-inch contraction are taken off on line A-H. For example, O is 4 inches long, common rule; R-S is 4 inches long with 5/32-inch contraction per foot added; X-Y is 4 inches, with 13/64-inch plus 7/32-inch contraction added.

THE PHILADELPHIA FOUNDRYMEN'S ASSOCIATION.

At the monthly meeting of the Philadelphia Foundrymen's Association, held at the Manufacturers' Club, Philadelphia, March 3, the committee on specifications for pig iron reported progress and requested criticisms from foundrymen on the scheme previously submitted covering standard pig iron specifications. Such communications should be addressed to Walter Wood, chairman, 400 Chestnut street, Philadelphia, at once, as the committee desires to submit this final report at the convention of the American Foundrymen's Association to be held the week of May 17, in Cincinnati.

W. M. Carr, of the firm of Carr & Speer, metallurgical engineers, New York city, presented a paper entitled "A Miniature Open-Hearth Furnace and its Adaptation to the Production of Small Tonnages of Light Steel Castings." This furnace was described in the January issue of The Foundry. The following concerns were elected to membership: Chester Steel Casting Co., Chester, Pa., Federal Steel Foundry Co., Chester, Pa., Brylgon Steel Casting Co., New Castle, Del.

CASTINGS FOR PRINTING PRESSES

Methods of molding large gray iron cylinders for printing press machines---Operations of a large eastern foundry

AN EXCELLENT illustration of the extent to which space limitations can be overcome in the design and operation of a foundry, is afforded at the plant of R. Hoe & Co., manufacturers of printing press machines at 504 Grand street, New York City. The Hoe works have occupied this site for a great many years, during which time the surroundings have become one of the most densely populated districts in the city, and the value of abutting property has now reached such a figure as to be practically prohibitive for manufacturing purposes. Some two or three years ago the Hoe interests found it necessary to provide more ample foundry facilities than those afforded by the limited department then devoted to that purpose, as not only was the capacity of the iron foundry inadequate to the company's increased needs, but the space occupied was sought for other purposes. The decision was then reached to erect a modern foundry building on the most available site near the main works, a tract some five or six blocks distant, located near the East River waterfront and almost directly underneath the new Williamsburg Bridge.

Arrangement of the Foundry.

The new foundry is a brick and steel structure, about 200 x 150 feet, with a receiving and storage yard enclosed by a high brick wall. To secure satisfactory facilities for handling and storing materials, it was necessary to plan most carefully for space economies, and for this reason as well as because of the unusual nature of the castings produced, the foundry is of particular interest.

The foundry walls are built extremely high to afford room for a spacious gallery running along either side of the building and across one end. The large light area around the roof and in the end walls provides exceptionally good lighting facilities, and there is little loss by reason of the gallery, owing to its elevation from the main floor. In fact, the bench molding and heavier core making departments are installed immediately beneath the galleries and ordinarily operate without artificial light. In this connection, however, it is interesting to note that the plan has been adopted with complete success of equipping each of the three large traveling cranes with two arc lamps, suspended about midway between the center and the wall and adjustable to any distance from the floor. The foundry is further equipped with a number of stationary arc lamps and several Cooper-Hewitts.

The Gallery.

The gallery is designed for light foundry work. At present, however, it is being employed principally for storage purposes, although it does afford room for the light core-making department, the tumbling barrel, grinding and polishing department and the carpenter shop. It provides storage space for coke, limestone, sea coal, sand blast sand and facings, a considerable quantity of surplus flasks, and other accessories. A few patterns are also kept here, although the more important are arranged in racks accessible only through the office. All of the patterns, however, are stored at the main works and sent to the foundry only as castings are required.

Sand Storage.

The facilities for sand storage and core baking are noteworthy in that they are secured by a double-deck arrangement. In the end of the building on which there is no gallery, a door is provided of sufficient size to admit large trucks. Near this door is an enclosed bucket conveyor, terminating at the top in a distributing spout through which an endless chain conveyor also runs. As rapidly as the molding sand is unloaded from the truck, it is carried up automatically and deposited in one of the two two-story bins, each sufficiently large to accommodate about 300 tons. These bins are arranged to discharge through doors located near the main floor and convenient to the sand mill, and a Pangborn combination screener and mixer. The walls of these bins are built up of hollow tiles in a steel framework, and they measure about 20 x 20 feet and are 30 feet in height. Their arrangement is illustrated in Fig. 2.

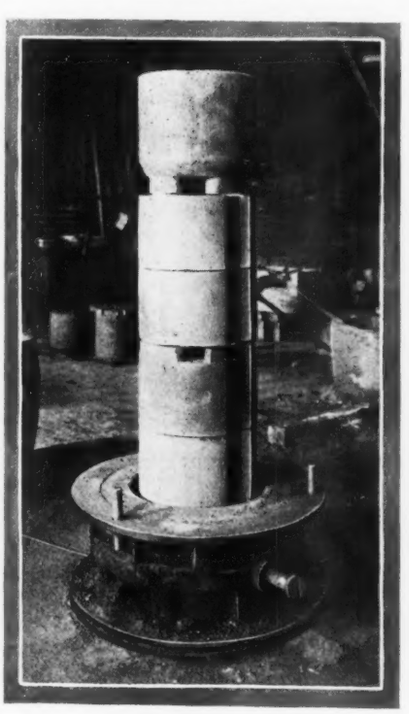


FIG. 1—METHOD OF BUILDING UP FLASKS AND CORE FOR A LARGE COLLECTING CYLINDER

Coke and Iron Storage.

A very similar arrangement is followed in the handling of coke, which is also stored in roomy bins on the gallery floor, which is on the level and immediately connected with the charging floor. From the street a large gateway through a high brick wall admits the company's trucks to an areaway of considerable size. Passage through this gate is over wagon scales and a strict record of weights of all traffic is kept. The court is paved with granite blocks, a feature which is not only of importance because of the wear incident to the use of heavy trucks, but which also renders it possible to keep the space free from the the rubbish usually seen about the yard devoted to the storage of foundry materials. In this court is stored a sufficient supply of pig iron and scrap to insure against any interruption of the melt, yet the perfect order which always prevails, as shown in Fig. 3, is remarkable. One of the blocks of iron is in the form of a hollow square, and in this is piled the scrap, only a high grade of machinery scrap being employed. The foundry creates considerable of the old material going into its cupolas, particularly because of the large heads required on heavy cylinder castings, which are machined off by a lathe specially fitted up for this work and broken up for remelting by means of a skull cracker. Cars on industrial tracks from the foundry collect the scrap and transfer it to this material yard, where it is mixed with the outside supply and sent to the charging floor as needed, by an elevator located immediate-

ly behind the cupolas and between them and the blower room. This is directly above the power plant, the blowers being driven by direct belt connection through openings in the floor.

Coke Handling Equipment.

Fig. 3 also illustrates the method employed in handling the coke supply. The bins in the gallery have a capacity of about 100 tons. As it is unloaded from the company's wagons, the coke is carried up by the bucket conveyor shown near the center of the photograph, no further rehandling being necessary except its transfer, as required, to the charging floor, in which large cars and two-wheeled trucks are brought into use.

Melting Equipment.

The cupolas are both Newtens, one having a 72-inch shell lined up to 56 inches, and the other a 60-inch shell lined to 47 inches. All pouring is done late in the afternoon. The usual run from the larger cupola is 27 to 30 tons in the period between 2:45 and 5:30 p. m., while the smaller yields ordinarily about 18 tons in this time. The cupolas are housed in a room built into the gallery between the coke bins on one side and the core and drying ovens on the other. The ovens are two-story, though entirely separate and individually fired; the lower is built with extremely large doors to admit a wide railroad car on which the cylinder molds are placed upright for drying. This arrangement is made clear in Fig. 4, which shows a buggy with standing cylinder molds, some of which have been partially dismantled for reassembling with the cores in place. This photograph also shows one of the molds for an ink fountain roll, a class of work extensively produced at this foundry.

The Product.

Owing to the nature of the castings turned out, hand molding is almost exclusively employed at the Hoe plant. On pinions, levers and other small parts produced in large numbers three Tabor light power squeezers are in use, and on small special pieces a considerable number of bench molders are kept busy setting up flasks by hand. But the energies of the foundry are of course chiefly centered on the production of printing press frames, rolls and cylinders. The casting of frames presents no unusual difficulties other than those resulting from the preparation and handling of flasks of considerable size, running up to 7 x 14 feet regularly and not infrequently being extended considerably beyond these limits. The casting of cylinders and rolls, however, does present some interesting problems in foundry practice, and the method in which these have been overcome has been a development of many years at the Hoe plant, which is one of the very few foundries in the country in which this class of work is carried on.

FIG. 2—TWO-STORY SAND BINS AT THE HOE FOUNDRY, CONSTRUCTED OF HOLLOW TILES ON A STEEL FRAMEWORK

Printing Press Cylinders.

Printing press cylinders go under a variety of names, the more common being type, impression, collecting and cutting-off, but all follow the same general lines so far as their production is concerned. These are heavy castings, the weight of a single type or impression frequently running up to 6,500 pounds, and measure in their finished state up to 24 inches in diameter by 81 inches in length, the latter exclusive of a crop of some twelve inches. These are cylindrical shells, cast with an average wall thickness of one inch; through the entire length runs a hub with which the shell is connected at various irregular intervals by series of spokes, the object being to secure the maximum of strength and absolute rigidity with a minimum of weight. Obviously the balancing must be perfect, and no deviation from the absolute centering of the core is permissible, particularly on the impression cylinders, where the slightest flaw in an absolutely smooth surface, even though almost imperceptible, means the rejection

FIG. 3—CONVEYOR IN THE YARD FOR TRANSFERRING COKE TO THE BINS IN THE GALLERY

FIG. 4—LARGE CYLINDER MOLDS ON A CORE OVEN CAR

of the casting. As these cylinders are machined only to a maximum depth of ¼-inch, the problem before the foundry can be appreciated.

Casting the Cylinders.

These cylinder castings are poured with the molds standing vertical in a pit, something after the manner employed in pipe-making. There are four such pits at the Hoe plant, each about eight feet in depth and constructed water-tight, owing to the proximity of the foundry to East River. A general view of these pits is given in Figs. 5 and 6, which also shows the method of building up the molds, cylindrical iron flasks of the company's own manufacture being exclusively employed. Fig. 1 showing the core of a large collecting cylinder partially assembled and with the lowest flask in place, affords a good idea of the manner in which the mold is produced.

In the preparation, for instance, of a mold for a large impression cylinder, some eight of these flasks are clamped together in the pit, end to end, the pattern is inserted and the entire mold is rammed. Then the pattern is drawn and the series of flasks transferred to the core oven buggy to remain in the oven over night. In Fig. 5 the pattern is partly drawn from the flasks in the foreground. Before the flasks are taken to the oven they are separated and slicked up in sections of two in order to secure a perfect parting, and are then re-assembled. The flasks are flanged, male and female, and are provided with dowel pins to make the joint certain and true.

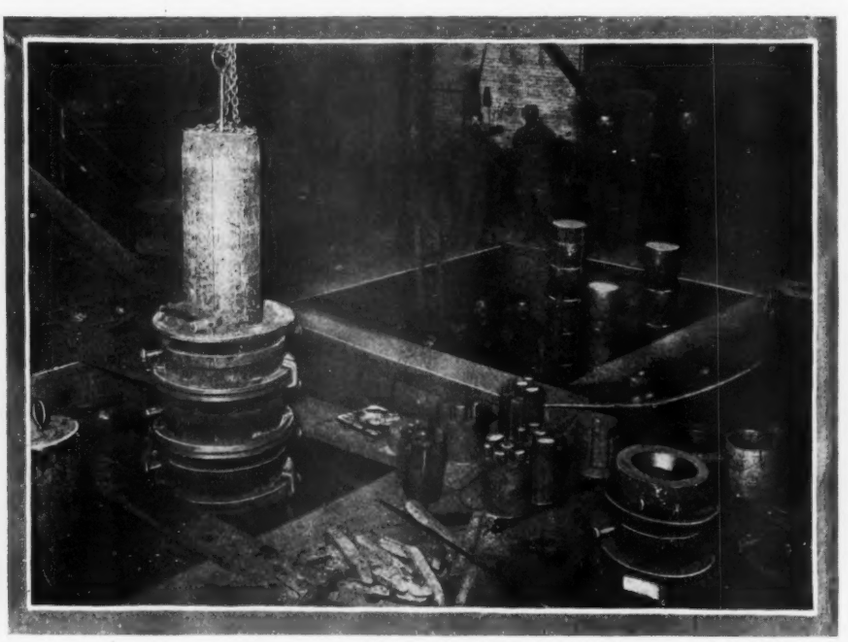


FIG. 5—CYLINDER CASTING PITS SHOWING SERIES OF FLASKS WITH PATTERNS PARTLY DRAWN. CORE SECTIONS ARE SHOWN AT THE SIDE

Building up the Cores.

The cores, except in the smallest sizes, are also prepared in sections, identical in height with the flasks, and these are baked separately. A number of core sections are shown at the edge of the pit in the foreground of Figs. 5 and 6, and the assembled cores of three different types of cylinder appear in the farther pit. The flasks are then re-assembled in one of the casting pits, a thin ring of putty being used as a safeguard against the iron breaking out between sections during the pouring operation, the core sections being assembled at the same time. The sectional method is employed because of the complex character of the core rendered necessary in securing the hub and spoke arrangement of the interior of the cylinder. The plan works out advantageously in the respect that the molder, as he builds up the mold, enjoys perfect access to the interior as far down as his arm will reach, thereby being enabled to produce perfect joints and to keep the core well centered. For pouring, the topmost flask is finished off with a bell-shaped head, which is machined off before the casting leaves the foundry. The mold, being poured vertically, is subjected to considerable strain from the impact of the molten metal falling a distance, in extreme cases, of approximately eight feet, but there is no loss from this cause. In fact, the percentage of rejected castings of this class for all causes is remarkably small, considering the exacting conditions they are called upon to fulfill.

Crane Equipment.

The pouring ladles are handled by one of the three 10-ton Northern cranes which span the foundry, but the casting pits are commanded by jibs and the large travelers are thus relieved of much of the lighter work, such as transferring flasks, drawing patterns, etc. After being shaken out, the cylinder castings are cleaned by hand, their character being such that the sand blast is unable to operate through their entire length. A sand blast department is provided, however, and operates with success on all the other castings produced. The tumbling barrel, grinding and polishing departments are located in one corner of the gallery, to which castings are conveyed in large boxes by one of the travelers.

A good example of the character of work done on frames, bed plates, braces

and other printing press parts of this kind is shown in Fig. 7 which illustrates the cope of a large side frame casting and several braces. These green sand castings commonly run up to 3,000 or 4,000 pounds each, and frequently present an interesting problem in pouring through the proximity of light and extremely heavy sections in the same flask. White beach sand is employed as a parting.

Power Plant.

The power plant is entirely independent and up-to-date, being equipped with a 150-horsepower boiler and 125-horsepower, direct-connected engine and dynamo, which furnishes all the electrical power and light, cupola blowers and a 300 cubic-foot steam driven air compressor that furnishes power for the sand blast, numerous sand shakers, lifts, hammers, blowers, etc.

The Hoe foundry is noteworthy in other particulars. Test bars are cast from each heat and broken in a Riehle machine, the records for a long period showing a surprising regularity. An effective order and follow-up system is employed, this affording particularly good results in the bench molding department where a large number of duplicate parts are produced. The apprentices at the foundry are required three times a week to attend the industrial school maintained by the company; they go direct from the foundry to a lunch provided without expense and then devote the remainder of the evening to school purposes. The course is one designed to meet the peculiar requirements of the machine shop and foundry apprentice.

ALLOY FOR BEARINGS.

Question:—Will you kindly give us an approximate analysis of the bronze wheel sent under separate cover. We would also like to have a bronze mixture for bearings for electric motors?

Answer:—As nearly as can be determined without a chemical analysis, the composition of the bronze wheel submitted is as follows: Copper 84, zinc 10, tin four and lead four. In all cases where the approximate analysis is desired a sample bar of the metal should be furnished if possible, the sample preferably to be square, about 1-inch across each face and 2 inches in length. This will permit an examination of the fracture of the alloy making the judgment of its contents much more certain. For rolling stock bearings, use copper 77, lead 15, and tin 8. This is a good alloy for any kind of bearings. K. K.

CAST STEEL ARMOR PLATE.

An interesting suggestion was made at a recent meeting of the Sheffield, Eng., branch of the British Foundrymen's Association. Whether it is possible to cast armor plates, a development which if carried out, would involve a revolution in the steel trade, was discussed. It is well known that our steel foundry in England has for some time been experimenting along this line, and that certain parts of armor are already produced in this way.

The matter was mentioned by Percy Longmuir in his lecture on "Alloys." He pointed out that ordinary steel castings are essentially alloys of iron and carbon, and such alloys with a third element are for the most part similar to forged steels. In the foundry special steels are at times produced as exemplified in the production of certain types of shell, tramway points and crossings. "No doubt," he added, "the time will come when cast armor will compete with and possibly replace forged armor."

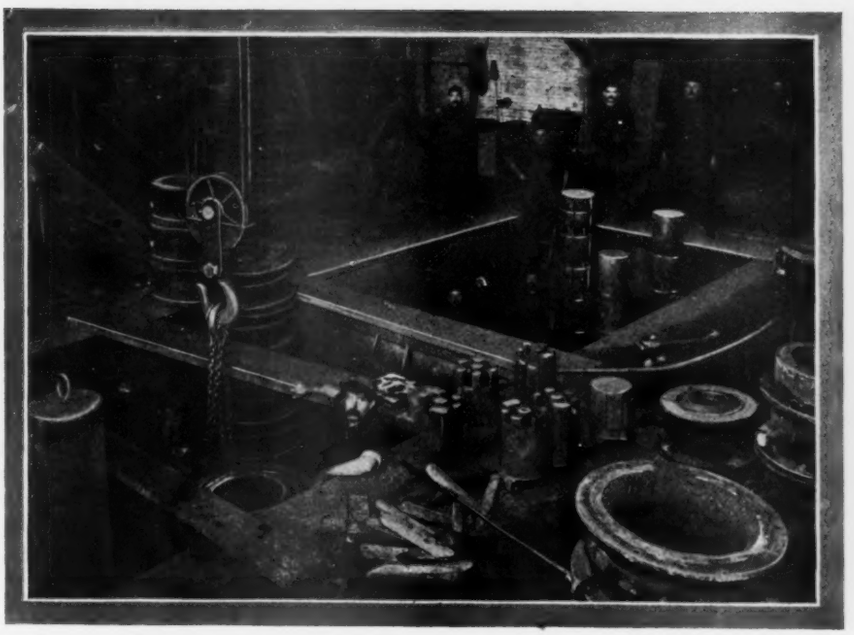


FIG. 6—CYLINDER CASTING PITS; THREE LARGE CYLINDERS ARE SHOWN IN THE FURTHEST PIT

The Avery Stamping Co., Cleveland, is now manufacturing a 40-pound pressed steel ladle which is beaded near its upper edge to hold it in the ring of the carrier shank also made by this concern. The 40-pound ladle is a recent addition to the line of 50, 100 and 150-pound ladles made by The Avery Stamping Co.

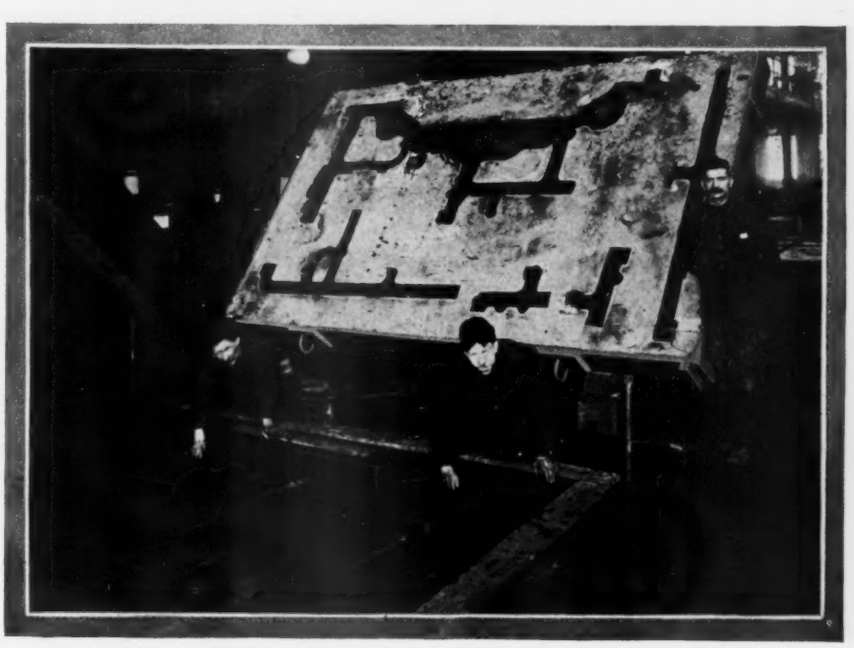


FIG. 7—LARGE MOLD OF A PRINTING PRESS FRAME. THE FLASK IS 7 x 12 FEET

PRODUCTION OF MALLEABLE CASTINGS-XIII

A further discussion of the malleable annealing process together with interesting experiments conducted to ascertain the action of the heat treatment

BY RICHARD MOLDENKE

ANNEALING the properly made hard castings is really a science, and many are the difficulties experienced where the proper means of control are not at hand. It may safely be said, however, that ten to one of the troubles encountered in annealing malleables come from improperly made hard castings, oxidized to a sufficient extent to resist heat treatment, and yet not showing this condition to the naked eye.

Let us suppose, however, that the castings were made right and have the proper composition. Then there are two ways in which the heat treatment, or annealing, as it is commonly called, may be carried out. First, a very high and short heating, and second a low and long one. The latter is the one used in this country for the production of the ordinary "black-heart" malleable, while the former is the *"ignis fatuus"* of the short-anneal inventor. With the higher temperatures, however, and longer time than even the regular American annealing process, we get the European "white-heart" malleable casting, and this is oftentimes produced here as well as when defective material is reannealed several times to make it pass muster in bending, twisting, etc., and to some extent also in the annealing of cupola work containing high sulphur.

"Black Heart" Castings.

"Black heart" malleable castings have a characteristic fracture. The core is a velvety black when the total carbon is at a maximum, and a lighter shade and of irregular structure when much steel is used in the mixture. A thin band of white forms the circumference—probably not over 1/16-inch in good work. Between the two lies a band of black of still lighter shade, corresponding to the crystalline structure of the original hard work, these particular crystals all being at right angles to the surface.

In the case of the European malleable the fracture is steely, with rather coarse structure. The material, however, bends excellently, and is very good, though slightly weaker than the "black heart." One seldom sees it this way in heavy sections, in fact when thick, it is inferior and not properly decarbonized.

A large number of annealing experiments were made in which a series of test bars were packed in scale the usual way, but enclosed in special, small, heavy boxes with iron covers, or in capped, iron pipes. Then these boxes or pipes were placed on top of selected pots with arrangements made to get them out of the oven as desired. These tests have given some clue to what goes on during the heat treatment. Normally, the process of annealing is to bring the oven up to heat as quickly as possible without exceeding the proper temperature; then to hold this maximum temperature for at least 60 hours; finally to let it drop as slowly as possible or convenient until black heat, when the pots may be drawn, allowed to cool still further, and finally dumped. In carrying out some of the above mentioned tests, enough boxes were filled with bars—all from the same part of the same first class heat of metal—and placed as far into the annealing oven as could be conveniently reached with a bar through an enlarged peephole in the door. Being on top of the pots, they got the full heat of the oven and naturally annealed quicker than the work in the pots themselves. One of these boxes was taken out every six hours, or four per day of 24 hours. After cooling, the bars were broken, and the fracture studied.

Color of Fracture.

It was very interesting to note how the color of the fracture became darker, shade by shade, but still held the crystalline formation intact. Then, minute spots of black appeared which, when lifted out with a fine needle under the microscope, proved to be lamp black that evidently had been separated out between the larger plates of crystalline iron. The crystalline structure then began to disappear and the carbon spots spread uniformly all over the fracture surface, but not from the edges inward, as might be expected. As the heat the bars received was greater than the pots, in a measure, the annealing to "black-heart" was completed some time ahead, and hence several bars could be taken out which had received too much heat. These showed decided "over-anneal," that is, the normal thin white edge spread inwardly, with a distinct crystalline, but entirely different appearance than the original hard metal, and not parallel to the edges, but closing in round on the central, black core. The tests always ended with this, but others made with a specially high heat, had this white crystalline fracture which completely obliterated the black core, and the metal broke off very short. Had the process continued, without having the heat exceed a danger zone, European "white heart" castings would have been produced.

Annealing Danger Zone.

That there is such a danger zone was distinctly, and in a very expensive way demonstrated one night, when the annealer preferred the congenial atmosphere of a Pittsburg "speak-easy" to his work. The pressure of the natural gas rose suddenly and for several hours the temperature of a bank of 20 ovens went up to an unknown point. Next morning, a sadder lot of pots could not be imagined. They were wilted, tops sunken, and when finally removed and sledged apart, gave a collection of castings bristling with an enameling of scale and fractures, the crystal facets of burnt iron—dead white—being up to ¼-inch across. This, of course, is seldom seen in a malleable foundry, but shows that a high temperature and a short anneal may lead to disaster until more of the fine points are known. For this reason, all ventures based on quick annealing methods have so far uniformly failed, unless a return was made to the established process. This does not mean that we will not learn more about this subject, but until we do, it is wiser to let well enough alone.

Temperature of the Pots.

We may, therefore, confine ourselves to the two standard processes. In the case of the "black-heart," mark well the temperature of the pots in the oven—***not the oven but the pots in the oven.*** They should be kept at such a temperature that when this is taken at the coldest spot on the coldest pot, in the coldest part of the oven (which is the lower part of pots in the front row, the oven being fired from the rear) it will be about 1,350 degrees, Fahr. It may be allowed to come up to 1,400 degrees for

a short time if the oven is in fine condition, and as low as 1,250 degrees if the oven is rather old and the range of temperature within larger; but 1,350 degrees is the best all around heat. This, of course, refers to furnace iron, either air or open-hearth. Cupola iron temperatures should be from 150 to 250 degrees higher.

In case natural gas is used, and the supply is inadequate, some risk must naturally be taken in the matter of temperatures, and the author has found that when 1,250 degrees Fahr. has been reached in the pots as above described, and this temperature maintained for a period of 12 hours continuously, the readings could fall to 1,100 and even 1,050 degrees for a brief period at a time, and good annealing results obtained. The front, or coldest row of pots would, however, have to be watched closely, so that unannealed work might not pass through. This was simply returned again, either without disturbing the pots when it was positively known, or repacked with the new castings made. It was thus possible, in spite of difficulties arising from a short supply of gas, to get out important work for quick shipment, as the interior of the ovens was always hotter than the front.

Time Required for the Anneal.

While is is advisable to give 60 hours after full temperature has been reached, this is by no means obligatory. An ordinary heat, instead of taking six days for the cycle, can be completed in four, even with such heavy work as couplers, but the results are not of the best for safety. This helps to explain, however, why it is possible to get annealing effects with lower temperatures. Indeed, investigations made by the Smithsonian Institute on meteorites have shown that it was possible to trace the change from combined to "temper" carbon as low as 800 degrees Fahr., provided sufficient time was allowed for it to take place. All ovens will not come up to the required heat at the same time, depending upon their construction and location with reference to the stack. Thus, the smaller type with strong draft, will be up to full heat in 24 to 36 hours, while the old fashioned double oven, if large, oftentimes takes 48 to 60 hours. If no leeway were permitted in the matter of holding up to the maximum temperature, it would not be possible to operate the annealing room with clock-like precision.

Dumping the Pots.

The pots should never be dumped while red hot. The metal always suffers. All the advantage gained by holding the temperature long and cooling very slowly is thus lost, and one might as well have made it a four-day affair. The immediate result can best be explained by noting the effect of hot-straightening a piece of malleable. If a casting has to be straightened before shipment because of warping in the anneal, this should be done cold. If made red hot and hammered, the "black-heart" will disappear, and the fracture becomes a brittle and finely, crystalline white. This is especially serious if only one end of the casting has been thus treated. It will break at that point every time. For very thin casting, this, of course, does not hold, as they are usually so decarbonized, even in the "black heart" process, that they would still bend and remain fairly soft, even if they should become white again. Some very interesting effects are obtained by hardening and tempering malleable castings, and this again forms the basis of much spurious "cast steel."

The trouble is, however, that sometimes a malleable casting is so sensitive that it becomes very brittle, if not actually white, when dumped red hot from the anneal. It becomes air-quenched. It is a well known fact that ovens drawn so that the dumping of the pots takes place on Monday morning, when they are perfectly cold, always yield the softest castings; hence, strict attention should be paid to this part of annealing room practice. When the ovens are ready to have the firing cease, they are opened very slightly shortly after, so that the heat can escape. This helps to reduce the time for this operation. If, however, this is not done judiciously, that is, if strong air currents are allowed to be set up in the interior, one can plainly notice the wasting of the pots, the draft carrying myriads of tiny sparks of burnt iron outward.

"White Heart" Castings.

For making the "white-heart" malleable castings, the annealing temperature is not only higher than for "black-heart," but longer continued. It would practically correspond to our cupola iron temperatures, and instead of 60 hours maximum in anneal after up to heat, it would be more nearly 100 or even 120 hours, with the same slow cooling.

Just why there should be a difference in the temperature required for castings of the same composition when made in the cupola or in air furnace, is one of the unsolved problems. It may be chemical in that the degree of oxidation has its effect on the opening up of the structure under the influence of heat. It may, on the other hand, be a matter of molecular physics, and depend on the construction and structure of the castings as made, either in the contact of fuel with iron, or not. Possibly it may be a combination of both, the chemical and the physical. Yet the problem still remains to be solved.

Action of the Anneal.

As to the occurrences in annealing, as previously stated, the *desideratum* is the conversion of the combined to an annealing carbon, called "temper carbon," whatever may become of this afterwards. In the "black heart" but little of this "temper carbon" is removed, and it is the opinion of the author that only that portion precipitated, as it were, out of the mass of iron, and lying in the band of crystalline material next to the skin which afterwards becomes gray or lighter than the centre core, is removed, and that it migrates out rather than combines with oxygen from the outside. It further migrates out faster near the skin than near the centre core. The author has invariably found that whenever oxygen did get into a casting in the anneal, through over-heating, and consequent undue opening up of the structure, or else through inability to resist penetration of oxygen by reason of too low an amount of silicon, it always gave the appearance of burnt iron. In fact it became the first part of the "white-heart" process. Unquestionably oxygen does play a part, taking out carbon by entering in the form of CO, this taking up an extra C, and passing out.

Thin Castings.

It is quite manifest that the latter process is going to be most effective in thin castings, and published tests of European iron seldom show thicker metal than ½-inch round, which means ¼-inch to put under the influence of the process, which again in turn means that if the very centre were unaffected, it would not affect the results. On the other hand, the "black-heart" process, which depends entirely upon the conversion of the combined carbon, can deal with castings several inches in thickness, provided these are cast in chills to get the metal white before annealing. The carbon removed from the skin, while acceptable, is not essential, and hence American practice, now already caring for fully 90 per cent of the world's production of malleable castings, will continue to dominate and will supplant the "white-heart" method still further.

Investigations conducted at the fuel testing plant of the United States geological survey at Denver, during 1908, into the washing and coking of the coals of the Rocky Mountain region, have just been reported upon by the survey. Of the 37 coals tested from this region all but three produced good coke under proper treatment, although a number of them had been considered non-coking.

MAKING MOLD JOINTS AND PARTINGS

An interesting discussion of elementary foundry work which contains many valuable suggestions for the experienced molder

BY JAMES F. BUCHANAN

IN ORDER to get a perfect reproduction of any object in cast metal, the mold must be enclosed and completely surrounded by some refractory material. The *cire perdu* process of molding fulfills this condition without necessitating the separation of the mold into sections, the reason being that the wax model or pattern which is of a temporary nature, can be expelled through some channel prepared beforehand by the application of heat.

FIG. 1—FLASK DESIGNED TO FOLLOW THE PARTING LINE OF THE MOLD

Open sand molding in which the use of a cope is dispensed with is a process of very limited scope, being suitable only for such castings as have a level upper surface. Owing to atmospheric influences and the cooling characteristics of the metals, the superfices of such castings always present a rough and spongy condition, which is quite undesirable in castings for general requirements. While neither of these two processes—the *cire perdu* process and open-sand molding, call for the divisional formation, or jointing of a mold; the former is too expensive and not practical enough and the latter is too crude and not comprehensive enough for making ordinary everyday castings in quantities. By the regular methods of molding in sand the molds are made up in parts, joints being necessary in order (a) to draw the pattern or patterns, (b) to facilitate the finishing of the mold and (c) to get a complete impression of all the pattern faces.

The Parting Line.

The manner of dividing the mold parts depends altogether upon the shape of the pattern; the line of division with reference to the pattern is called the parting line; with reference to the mold faces it is called the joint. When special flasks are to be made for a running job the due consideration of the joints necessary for molding may lead to great economy in the output. Figs. 1 and 2 are simple examples of flasks designed to eliminate labor in preparing the joint as well as to economize sand, gaggers and ramming the mold. The preparation of a dummy cope or match requires some skill in setting out patterns so that they will relieve themselves freely both in the joint and in the mold. In many cases the pattern construction decides the parting line question, but, if a series of patterns with irregular partings is to be arranged in one flask, some ingenuity and care is required in laying out and spacing so as to get a compact mold that will part well and still be strong enough to stand handling and to resist the pressure of the metal. A good exercise for the young molder is marking off the best parting line on a number of differently shaped pieces. Beginning with the easiest geometrical figures, the circle, square, triangle, hexagon, etc., Fig. 3, and following up this with the study of some irregular forms, we soon get close to the average conditions met with in ordinary molding practice.

Deep Lifts in the Cope.

One of the principal points to be observed in locating the parting line is the avoidance of deep lifts in the cope. Fig. 4 illustrates the wrong position for a common bracket casting. By placing this pattern on its side, shown at A, the molding is simplified considerably. The next rule in setting patterns for molding is to arrange for as much as possible of the casting to be in the drag.

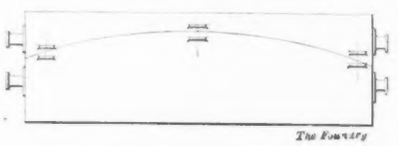


FIG. 2—ANOTHER SPECIAL FLASK FOR A MOLD WITH AN IRREGULAR PARTING

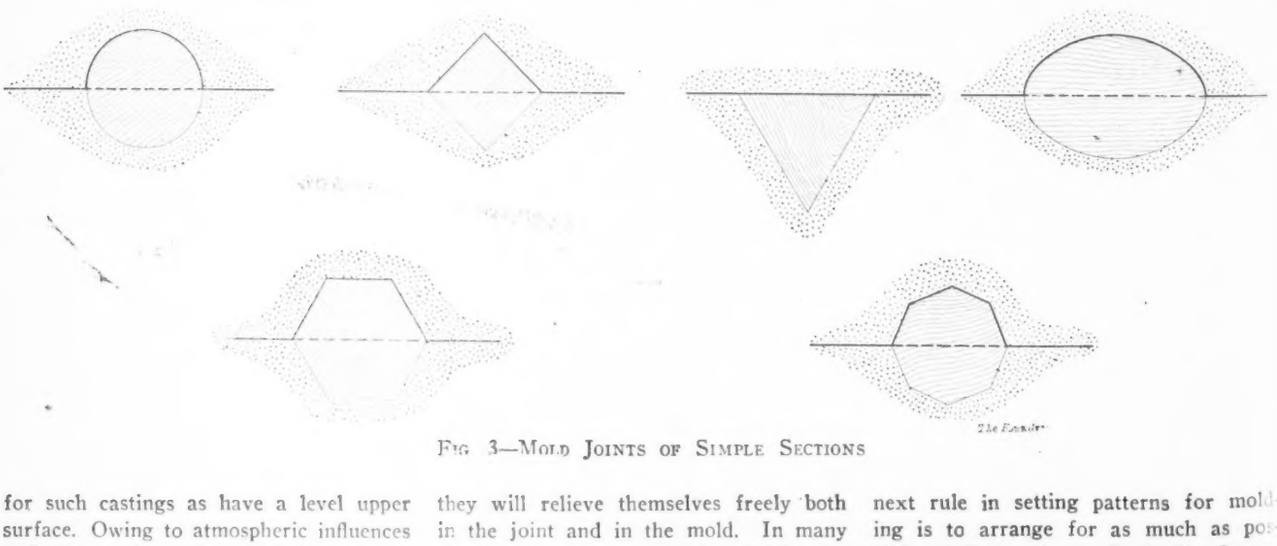


FIG. 3—MOLD JOINTS OF SIMPLE SECTIONS

Although patterns which give unequal division have generally the deeper pock-

ets and projections placed in the drag, this is not always practical. To overcome machining and shrinkage difficulties, the reversed position might be deliberately chosen and with sound reason. The combined valve and spindle, Fig. 5, is a case in a case in point. Cast in the horizontal position the valve face is liable to be dirty on the top side; cast as at A, there is not much improvement, but the latter position reversed gets over the trouble by breaking the first rule mentioned, viz.: to place as much of the casting as possible in the drag part of the mold.

Next to a deep lift in the cope, or a vertical projection above the drag, a steep incline on the joint is the least desirable form of parting to make, more

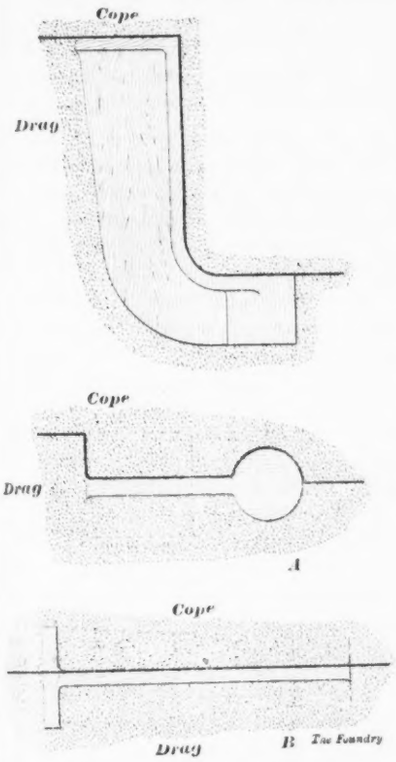


FIG. 4—PROPER AND IMPROPER METHODS OF MOLDING A BRACKET

particularly if it intersects a face of the casting. Better work would result from the pattern, Fig. 6, if one of the square flanges were made loose; a straight horizontal joint would then suffice and the piece could then be made like a sheave. Again, B Fig. 4, which is another view of the bracket, would be much easier to mold if the pattern were split along the parting line shown. A split pattern is nearly always a boon to the molder, provided it is split in the place in which the molder would joint the mold, and not in the place selected by the patternmaker for jointing up the wood regardless of the other fellows' part of the work. For standard work the split pattern is a great money saver, but for occasional castings, the extra expense of making a pattern in halves would not be justified. This question like the location of the parting line for intricate designs should be decided by a conference of patternmaker and molder; both are deeply interested in economizing the work and the prime costs.

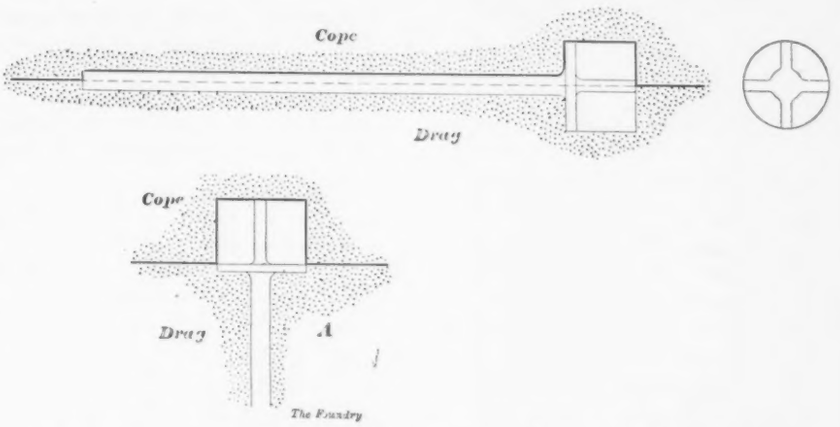


FIG. 5—PROPER AND IMPROPER METHODS OF MOLDING A VALVE AND SPINDLE

Parting on Molding Machine Work.

In machine molding the depth of draw may fix the line of parting in quite another direction from the hand molding method. For example, with machine guides and stripping plates and the precision of the "part" or separation of the mold, the vertical draw or lift due to a pocket or projection in the cope ceases to be an obstacle. And further, the more uniform ramming of the machine may mark in its favor as against hand ramming, the difference between success and failure in the parting and handling of the cope. The making of the mold joint has a lot to do with the success of molding and the outside appearance of the casting is generally indicative of the skill exercised in parting the pattern and making up the joint. Serious defects may exist in the internal parts of a casting without being detected, but minor flaws on the outside arrest the eye and condemn the molder, if not the casting. A careful molder may always be known by the joints and partings he makes. Usually, when the cope is first lifted off the parting is as good as the joint will allow. Badly formed joints and poorly selected parting lines are responsible for many bad lifts in sand molding.

After discounting the faults of gaggering and other irregularities, such as the uncertainty of the hand lift, or the wear and play of flask pins or stakes, the broken condition of the cope when parted will, in all probabilities, be due to unsuitable parting lines or a bad joint. The first requisite of a good joint is draft. Where the parting line is very irregular and broken, the various planes in which the two or more parts of the mold are separated must be blended

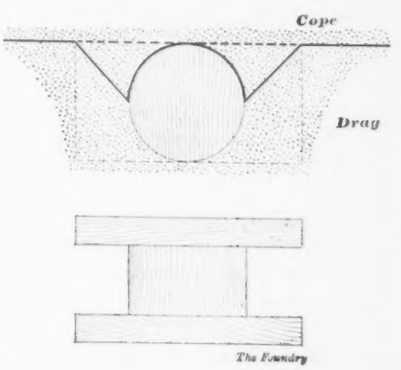


FIG. 6—PATTERN MADE WITH A LOOSE FLANGE SECTION

gradually into one another. The abrupt intersection of the planes—a sudden rise or dip, is easily avoided by using a flask of larger area. Hence, the second feature of a good joint is surface ample enough to afford easy graduations. The form of the joint is also important, its

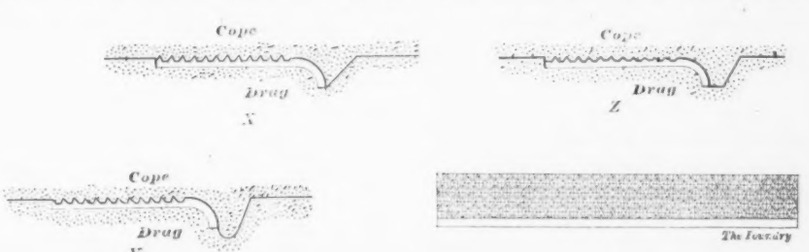


FIG. 7—THREE TYPES OF JOINTS FOR A STAIR TREAD CASTING

value being greatest when the bearing surfaces coincide with the flask divisions, the two surfaces coming evenly together in the same horizontal plane. Where the parting line varies, curved or diagonal joints are adopted according to the outline required.

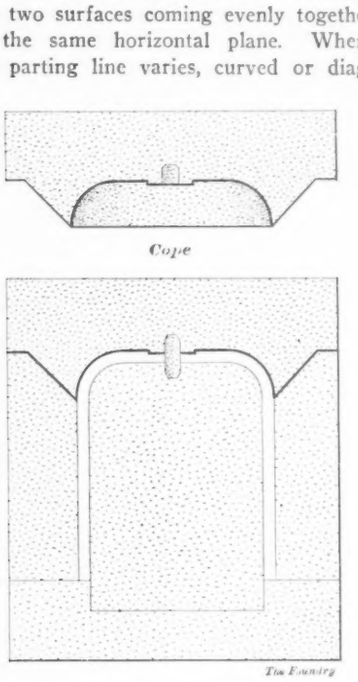


FIG. 8—ACUTE ANGLE JOINT ON TOP OF DOME

Stair Tread.

In Fig. 7, three forms of joints are shown on a common stair tread casting. The acute angle at X shows a weak construction which has always a tendency to crush, particularly in a dry sand mold. The curved part at Y is decidedly stronger, but it is open to objection because it is carried under the bottom edge of the pattern and in ramming the joint is liable to be pressed inwards so as to undercut this edge. The other form, the obtuse angle at Z has all the advantages of draft and bearing surface without the weakness pointed out at X and Y. Of course, the joint formation is regulated by the shape of the pattern.

In Fig. 8, the acute angle joint on the top of the dome is the natural line of parting and being circular it is not nearly so weak as at Y, Fig. 7. Another illustration of this style of joint is seen in Fig. 9. This is sometimes used when cores are to be lifted away for finishing exterior parts of the mold; the joint enables them to be replaced in their true position.

Hardly a pattern comes into the foundry but is capable of being parted in two or more ways and the question is not always, "Which is the easiest parting line to follow?" but rather, "Which method of molding will produce the soundest casting?" Fig. 10 is shown in two views with alternative partings. Owing to the boss being so much heavier than the other parts, the upper setting with the whole of the pattern in the drag is to be preferred. Fig. 11 refers to another example of the obtuse angle in making the joint. In this case drop prints are used so as to avoid breaking up the joint too much.

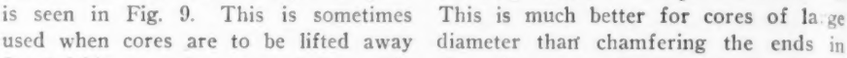


FIG. 9—ANOTHER ILLUSTRATION OF AN ACUTE ANGLE JOINT

Avoiding Fins.

Many other devices are used in fitting molds and cores together to make them register, and to avoid fins and crushes. In the matter of fins, a common practice in jobbing foundries is to cut up the face of the mold with the joint of the trowel as in Fig. 13, to prevent leakage. Another very good practice is making up the ends of prints as in Fig. 12, to avoid crushing when the cope is fitted on. This is much better for cores of large diameter than chamfering the ends in the print as at P, Fig. 13, for if the metal should get into the print it is certain to choke the vent, whereas the built-up print, Fig. 12, protects the vent.

Showing the need for discussion and that the patternmaker's idea of parting a job does not always coincide with the molder's, Fig. 14 gives the plan and sectional elevation of a pattern sent in to our foundry lately. The pattern had been turned from the solid and in ordinary circumstances such a plain piece would be parted through the diameter and cast horizontally. It was desired, however, that it be cast in the vertical position as shown. Instead of leaving a print on both ends and allowing the molder to mold it in the horizontal position and cast it upright, the patternmaker cut the top end flush and then hatched in a circle in blue pencil to indicate that the cone came through. The result was extra labor to the molder mending up the cope, which could not be expected to part well owing to the steep incline at S, as well as extra trou-

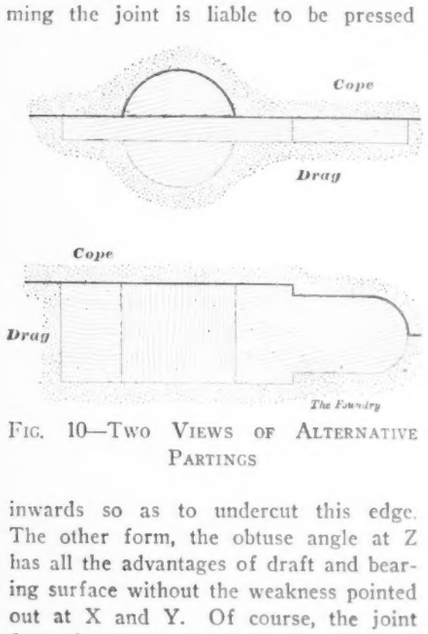


FIG. 10—TWO VIEWS OF ALTERNATIVE PARTINGS

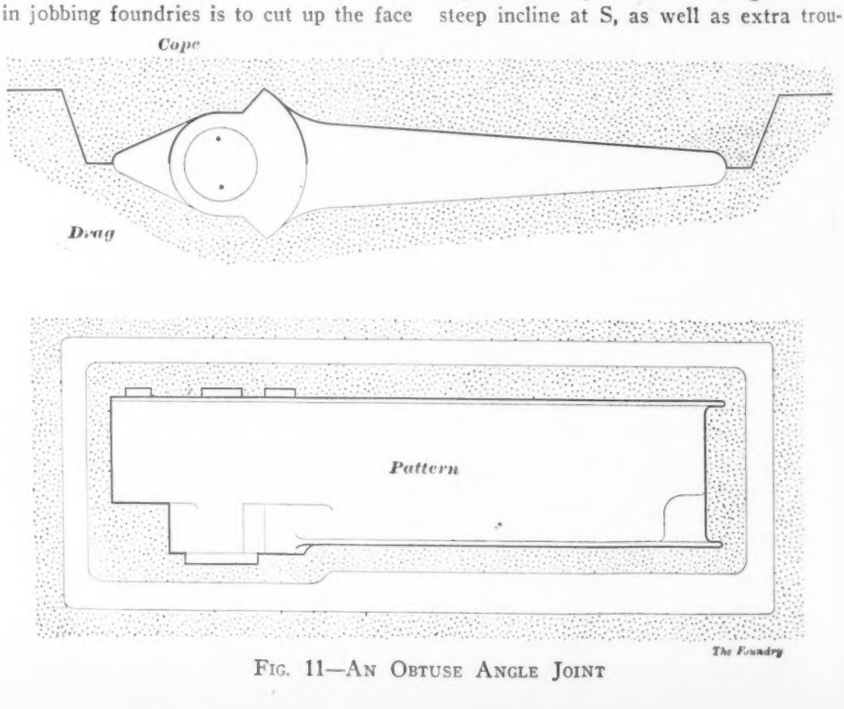


FIG. 11—AN OBTUSE ANGLE JOINT

ble in ramming a deep drag and in centering the core. The fact that such easy patterns can be made so inconvenient for the molder confirms the need for a closer association of the departmental heads.

Lifting the Cope.

We have learned that the abutting portions of a mold should be so formed that there will be a clearance as soon as they begin to separate. The lifting off of the cope is not the lottery that some molders believe it to be. With a good joint and the parting line in the right place, the delivery of the cope half of the pattern should be almost as good as the drag portion. Certainly, the cope is parted at big disadvantage because the effect cannot be seen until it is raised off the pattern. Starting the cope is therefore an important movement in the separation of the parts. Generally, the cope is started evenly in the plane of the joint, but with some irregular partings

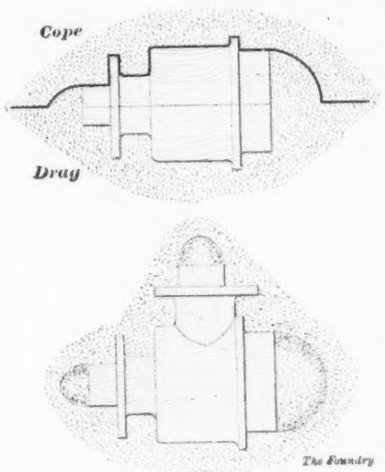


FIG. 12—METHOD OF BUILDING UP ENDS OF PRINTS TO PREVENT CRUSHING WHEN THE COPE IS FITTED ON

a better lift may result through raising one side slightly before the other. Where the draw in the cope is unavoidably deep, instead of lifting the cope off the pattern an iron or wood screw, according to the style of pattern (metal or wood) is sometimes inserted through the top of the mold and the pattern is then raised along with the cope, or the complete mold may be rolled over and the drag containing the pattern is then parted away from the cope.

Sand.

The quality and temper of the sand may cause a bad lift when all the other required conditions are right, but as a rule the majority of the bad lifts are due to carelessness in ramming or parting. Sand pockets and sharp angles should be avoided in mold joints. The wedge like formation of X, Fig. 7, is always objectionable because it cuts direct from one horizontal plane to another, and it cannot be mended so easily as if it stepped on to the parting plane some distance away from the edge of the pattern as in Fig. 11. With cored work

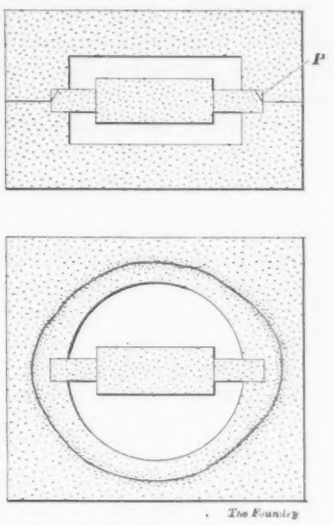


FIG. 13—FACE OF THE MOLD CUT TO PREVENT THE LEAKAGE OF THE METAL

it sometimes happens that the parting has to be made in an awkward place to avoid the necessity for chaplets. However difficult the parting may be, there are compensations in a well formed joint; one that can be gaggered properly and mended comfortably if need be. The economic advantages of spreading the joint in the lower plane before it takes a rise—terracing it might be called—are therefore well worth considering.

COKE CONSUMPTION IN THE CUPOLA.

There was an unusually large attendance at a recent meeting of the Birmingham branch of the British Foundrymen's Association, the subject for discussion being "Coke Consumption in Cupola Practice."

R. Mason considered that in the majority of cupolas too much air was blown in for economical melting. The customary complaint, when there is anything wrong, is that there was not enough blast, but that complaint is generally made without any knowledge of the amount of air that has been blown in or is required to be blown in. In comparisons with regard to coke consumption and blast he held that the cupola diameter should be measured inside the brick work at the bosh. It is a grave mistake to blow in more than 30,000 cubic feet of air per ton melted. He believed 28,000 cubic feet per ton is sufficient. Taking the measurements at the point he suggested, the following table showed the average rate at which cupolas of the respective diameters given would melt when melting continuously for three or more hours:

Diameter, inches.	Melt, per hour, pounds.
20	2,500
24	3,700
30	6,000
36	8,500
43	12,000
48	15,000
54	18,100
60	23,500
62	25,100
66	29,500

He mentioned an instance of a furnace in which complaint was made that too little air was blown in, but he persuaded his friend to try blowing in less air and it was found that

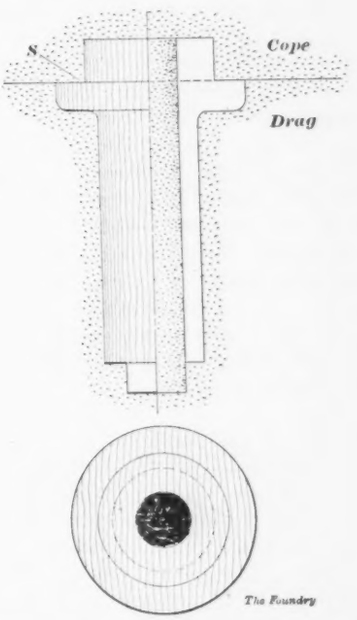


FIG. 14—A SIMPLE PATTERN POORLY CONSTRUCTED

not only was the coke consumption reduced, but the quality of the castings was improved, and altogether a very large economy was effected. Mr. Mason cautioned foundrymen when reading results of furnace practice to bear in mind the fact that in America the ton was 2,000 pounds, whereas, in England when they spoke of a ton they always had in mind a ton of 2,240 pounds.

George Hailstone contended that all coke coming in to the foundry should be analyzed. He submitted a table giving analyses of 16 British cokes, and said that only six of these satisfied him as being really good for cupola use. His specification for a good foundry coke was as follows: Ash, not exceeding 8 per cent; sulphur, not exceeding 0.75 per cent; fixed carbon, never less than 88 per cent.

Mr. Sadler suggested that the society appoint a committee to collect information and standardize cupola operations. At present a great diversity of results are reported at their meetings on account of the great diversity of conditions. All these points should be tabulated and then they would know how to apply, to their own particular practice, the various results that were brought under their notice.

Mr. Poole also thought it might be possible to fix some definite standard.

Mr. Pemberton stated that with a cupola 40 inches in diameter, a total tuyere area of 52.8 inches and a depth of the cupola of 16 feet, 10 inches from the back to the charging door, he got, when using a blast pressure of 18 inches of water, 15.4 tons of iron with one ton of coke. He emphasized the importance of having a good high bed of coke to start with. Everything that came into the furnace, including the limestone flux, should be carefully weighed.

R. Buchanan read a letter which he received from F. J. Cook, president of the national organization. In the course of this letter he said: "The points I should lay stress upon if I were able to be present are: We buy by weight and use by volume; it is therefore essential that the coke should be as light as possible that will carry a good burden. The heat qualities are due to the carbon and this should never be below 90 per cent. Most of the good coke I know of contains 90 to 92 per cent. Sulphur, for obvious reasons, should be as low as possible, 0.6 per cent being as low as is practicable, but I should begin to grumble if it reached 0.8 per cent. To insure hard coke that will carry a good burden it should contain a fair amount of ash, and a reasonable amount is from 6 to 8 per cent. For most classes of castings, especially when they have to be machined, it is imperative that the metal should be melted very hot; it is therefore misapplied economy to skimp coke, and have a resultant high percentage of scrap castings. On the other hand it is very bad to overdo the amount of coke as it costs more all around, being longer in melting as well as costly in coke. I am afraid with many men there is not sufficient consistency to get coke down to a reasonable amount, the easiest plan being to let well enough alone and let the cupola men have their own way."

Continuing, Mr. Buchanan said that they were getting away from the idea, so prevalent a few years ago, that the more air in the cupola the better the melting. On the whole it was clear that they had been blowing in too much air and putting too much coke into their furnaces.

PATTERN STORAGE SYSTEM.

By C. J. Fry

The following system was devised and put into use by one of the large steel casting concerns in the country, and has been found to be a time and money-saver. The foundry makes a specialty of castings from patterns furnished by the customer, and while some patterns are ordered returned with the castings most of them are stored and castings are ordered from time to time as required. A large pattern shop is operated in connection with the foundry where repairs are made and patterns produced for outside firms.

The system hinges on the card shown in Fig. 1, which is filled out in duplicate whenever a pattern is received. One card is kept in the office case, filed under the firm name, the other is filed in the storage cupboard shown in Fig. 2. This cupboard and the shelves are in such a position that a good photograph could not be made.

When a pattern is received the first six places are filled in and the pattern assigned to a shelf and section. The pattern generally has a number of its own, but if not one is supplied. If the pattern goes to the foundry the card goes into the division marked "Foundry," at the end of the assigned shelf. There is a row of pigeon holes for each shelf, one for each section and one at the end for the foundry. When the pattern is returned to the storage, the card is filed in its own section pigeon hole and the pattern placed on the shelf. Hence, a glance at the cupboard tells whether the pattern is on the shelf or in the foundry.

When the pattern is returned to the customer the office card is filled in with the date, address, route, condition and any remarks which might prove interesting or valuable in the future. The storage card is destroyed, but the office card is filed under the firm name in a separate index. Only cards belonging to patterns in storage or at the foundry are kept in the live index and in the storage cupboard.

This system takes care of the patterns alone, as the number of castings and other data are taken care of by the foundry office.

THE STEEL CASTINGS CO.
PATTERN STORAGE CARD

Received _____ Condition _____
Description _____ Valuation _____
Core Boxes _____ No.Pcs.of Pattern _____
Returned _____ Route _____
Address _____
Condition _____
Remarks _____

Section _____ Shelf _____ Patt.No. _____
Owner's Name _____

The Foundry

Fig. 1—Pattern Storage Card

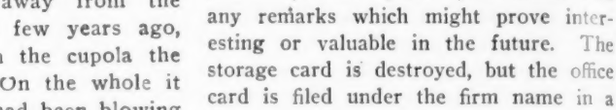


Fig. 2—Card Cabinet

FEATURES OF PACIFIC COAST IRON MARKET.

Probably very few people in the United States, even among those directly engaged in the iron business, know that nearly three-fourths of the pig iron melted on the Pacific coast is imported from foreign sources and is not American iron at all. This fact, coupled with the extreme distance between the purchaser and the furnace, and the large area over which a relatively small tonnage is distributed, creates peculiar conditions in the Pacific coast iron market not found anywhere else in the United States, and probably nowhere else in the world.

The estimated annual consumption of foundry iron on the Pacific coast is as follows: British Columbia, 7,000 tons; Washington, 18,000 tons;

Oregon, 16,000 tons; California, 70,000 tons; total 111,000 tons. Of this amount about 80,000 tons is imported. Most of the domestic iron comes from Alabama and is consumed in California and eastern Washington; but very little is melted west of the Cascade mountains in Washington, Oregon and British Columbia.

The imported iron comes chiefly from four countries: China, Scotland, Germany and England.

The Chinese iron is manufactured from native ores at the Hanyang Iron & Steel Works, China. This plant is operated by the Imperial Chinese government and aside from some iron sold in Japan, that which comes to the Pacific coast is believed to be all that is exported. Only the No. 1 grade is shipped to the Pacific coast. Its analysis is as follows: Silicon, 2.5 to 3.0 per cent; manganese, 0.5 to 1.0 per cent; phosphorus, 0.1 per cent; sulphur, 0.02 to 0.04 per cent; carbon, 3.2 to 3.5 per cent. This corresponds very well with the usual analyses of No. 1 American foundry iron.

Scotch iron is imported in limited quantities and has been used mostly on government contracts and for special work; some Scotch pig has also been purchased by the Pacific coast navy yards. Only the best grade of Glengarnock gray foundry is imported and its price on the Pacific coast is seldom less than $28 a gross ton. The average price is about $32.

German iron is imported intermittently; occasional ships clearing from German ports have brought it to the Pacific coast.

Fully 80 per cent of the imported iron comes from England, the Cleveland furnaces furnishing the greater tonnage. Cleveland No. 1 is a favorite grade. In a recent inquiry, out of 13 foundries eight specified Cleveland No. 1 or its equivalent. The iron is sold almost entirely by fracture. The Pacific coast foundries wish an iron that will carry as large a burden of scrap as possible, because the price of scrap is only 75 per cent of the price of No. 1 pig and the pig is so costly that every reasonable expedient that will reduce the cost of melted iron is adopted. For this reason it is extremely difficult to sell iron below No. 1 grade on the Pacific coast.

A group of resident pig iron brokers located at Seattle, Portland, Ore., and San Francisco and the Pacific coast representatives of various large English shipping and importing firms, form the two main agencies in the handling and distribution of the pig iron on the Pacific coast. Most of the iron is handled by the regular brokers. The importing firms enter the market spasmodically and during times of stress like the past year handle practically no pig iron whatever. At the best they are a disturbing factor in the trade. The sale of pig iron is only an incident to their main business of shipping grain and lumber and they do not always aim to make a profit on their iron transactions. The principal brokers of pig iron are the United Steel & Equipment Co., Seattle; E. P. Jamison & Co., Seattle; Chas. F. Beebe, Portland, and Henry Lund & Co., San Francisco. The principal importers who deal occasionally in pig iron are Balfour, Guthrie & Co., Kerr, Gifford & Co. of London and the Dollar Steamship Co. of San Francisco.

The distance between the English furnaces and the Pacific coast foundries is roughly 15,000 miles. This distance is so great that it would be uneconomical to ship iron were it not for certain special conditions which produce low freight rates.

Every fall there are a large number of cargoes of grain shipped from Puget Sound and the Columbia river to Europe. The grain ships arrive for loading any time between February and October and the grain is all dispatched between September and January. Throughout the entire year, there are cargoes of lumber being shipped to Australia and to Europe. This slow freight is carried almost exclusively in sailing ships. All this cargo, both grain and lumber, is outward bound and the ships have to return from Europe empty, ballasted with sand or pig iron. For this reason, since the ships must come to the Pacific coast anyhow to get their cargoes, they prefer to carry pig iron at a low rate than to carry sand for nothing besides paying the expense of its loading and unloading. The rate on pig iron is from $3.50 to $7.00 a ton; the shipowners charge whatever they can get.

This creates peculiar conditions in the Pacific coast iron market. Often there will be two ships on the way, one carrying iron at say $4.00 and the other at $6.00 a ton. Obviously, if the broker sells all the iron based on the $4.00 rate, he will lose money, or if he sells it all based on the higher rate, he may have difficulty in disposing of it. The actual value of the iron in both cases is the same. Each cargo is therefore treated as a unit and a price fixed. The broker will try to first sell out the higher priced cargo and will then offer the lower one. In case the lower freight rate was obtained by a competitor, he will have to meet the lower price and lose money on this shipment. Or market conditions may be poor, forcing a low price. It is often a rather uncertain venture for the broker.

As soon as the ship leaves England, the broker begins to sell the iron "to arrive" by a certain date. Inasmuch as the ship may be from four to seven months on the way, depending on the weather, the date of delivery is very uncertain and the early buyers are compensated for this by a reduced price. As the ship progresses and is reported now and then, the date of delivery becomes more certain and the price of iron is raised accordingly. When the ship arrives, the iron is sold at the spot price. Thus on a recent cargo, some of the iron was sold at $22.50 just after the ship left England; a couple of months later it was $24.00 and on arrival was $27.00. This offers quite an inducement to the foundryman to buy for extended future deliveries.

Market prices are very mixed and uncertain on the coast. The price for future delivery is dependent entirely on the cost at the furnace and the freight rate obtained for the particular shipment question.

Spot prices depend on the visible supply and the demand. Often weather conditions will be such that three ships leaving England a month apart will arrive all at once. This gluts the market with iron and depresses the spot price. Again, as was recently the case, the expected cargoes do not arrive, stocks become very low, the demand increases and the spot price soars.

In the east, a foundryman can contract for the delivery of a certain number of tons a month at the market price. In the west this is impossible. He may buy, for future delivery, iron on a certain ship for a stipulated price. This may arrive when he wants it or it may come 60 days before or after it is needed. Occasionally the ship sinks and the iron never arrives. If he does not buy in this way and take chances on the delivery, he has to pay at least $1.50 more per ton for spot iron and run the risk of the price being much higher. To buy economically under these conditions requires unusual foresight. At the best, the element of chance is large.

At coast points, the overland freight rates are such that domestic iron is rarely less than $1.00 a ton higher than the foreign brands. Usually the difference is greater.

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A Unique and Charitable System

To avoid the discharge of many molders who have been in his employ for many years, and who would be thrown out of work by the general installation of molding machines throughout his shop, one western foundryman has adopted a unique plan of installing these labor saving devices which is prompted by the most charitable motives. When the first machine was installed a handyman was selected as the operator. The molders were notified that none would lose his position and that the increased output would probably be just sufficient to cover the growing demand for the product manufactured. The record of the employment department showed an annual change in the working force of about 25 per cent, and instead of replacing the molders who left to seek employment elsewhere from time to time, it was decided to install molding machines of sufficient capacity to cover the daily output of the molding force that had resigned. In addition, the annual increase in demand for the line of castings made has averaged about 25 per cent, and molding machines will be installed to provide for this increment of growth. By pursuing this plan it is estimated that the entire molding force can be replaced in three or four years by machines without the necessity of discharging any of the molders, who are given first chance for positions as machine operators.

Trade Outlook

During the last 30 days there has been a noticeable improvement in foundry trade conditions and the open market on steel products has not as yet affected the foundry business unfavorably. Jobbing founders are figuring on more work than for some time and while prices are low, nevertheless the number of specifications that are being received indicate a slight revival. Specialty shops, notably those producing hardware castings, with few exceptions, are operating at capacity, the spring trade being practically normal. The steel casting output continues at about an average of 40 per cent below the production of 1907, and is about on a level with the demand last year. This is almost entirely due to the curtailed railroad requirements. Many of the malleable plants are busy on work for the implement makers, although the tonnage for the railroads is light. The requirements of brass and aluminum castings for the automobile trade are heavy, although plumbers' supplies show little activity. Owing to the unsettled conditions of the iron market, brought about by lower prices for steel products, foundrymen generally are deferring purchases believing that lower quotations will be named. In the leading centers No. 2 foundry iron is held as follows: Philadelphia, $16.25; southern, Cincinnati, $14.75; local, Chicago, $16.50; southern, Birmingham, $12; local, Cleveland, $15.75; basic, Pittsburg, $15.90 and Lake Superior charcoal, Chicago, $19.50.

Decline in Steel Casting Production

The production of open-hearth steel castings during 1908 showed a decline of 58 per cent, or 434,748 tons, over 1907, the total output having amounted to only 311,777 tons, as compared with 746,525 tons the previous year. The curtailed buying on the part of the railroads is reflected in these figures, inasmuch as these interests consume practically 60 per cent of the steel castings made in the United States. Of the total production in 1908, 156,772 tons, or over 50.2 per cent, were made by the acid process and 155,005 tons, or over 49.7 per cent, were made by the basic process. As compared with 1907, when 380,049 tons of castings were produced by the acid process, the decrease in 1908 by this process was 223,277 tons. By the basic process the decrease was 211,471 tons, the production in 1907 having amounted to 366,476 tons. The following table gives the production of open-hearth steel castings by both the basic and acid processes in 1908 by states in gross tons:

States—Gross tons.	Basic castings	Acid castings	Total, Gross tons
New Eng., N. Y., and N. J.	31,094	22,061	53,155
Pennsylvania	31,271	82,444	113,715
Ohio, Ill., and other States	92,640	52,267	144,907
Total for 1908..	155,005	156,772	311,777
Total for 1907..	366,476	380,049	746,525

Railroad requirements of steel castings are, however, constantly increasing, this material being used more extensively in the construction of cars and locomotives than heretofore. Many gray and malleable iron, as well as forged sections, are now being made of cast steel. Tests of cast steel locomotive cylinders recently made by several leading trunk lines show a longer life and better wearing qualities for steel than those made of gray iron, and large contracts for cylinders have recently been placed with several steel foundries. Locomotive tender frames are likewise being successfully cast in one piece in several steel foundries, and from eight to nine tons of steel castings are

THE FOUNDRY DATA SHEET, APRIL, 1909.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

TABLE OF DIMENSIONS OF POLYGONS.

$$\text{Co-efficient} = \frac{\text{Diameter}}{\text{Side}} \qquad \text{Side} = \frac{\text{Diameter}}{\text{Co-efficient}}$$

$$\text{Diameter} = \text{Co-efficient} \times \text{Side.}$$

No. of Sides.	Coef.	No. of Sides.	Coef.	No. of Sides.	Coef.	No. of Sides.	Coef.	No. of Sides.	Coef.	No. of Sides.	Coef.
3	1.16	28	8.93	53	16.88	78	24.83	103	32.79	128	40.75
4	1.41	29	9.25	54	17.20	79	25.15	104	33.11	129	41.07
5	1.70	30	9.57	55	17.52	80	25.47	105	33.43	130	41.38
6	2.00	31	9.88	56	17.83	81	25.79	106	33.74	131	41.70
7	2.31	32	10.20	57	18.15	82	26.11	107	34.06	132	42.02
8	2.61	33	10.52	58	18.47	83	26.43	108	34.38	133	42.34
9	2.93	34	10.84	59	18.79	84	26.74	109	34.70	134	42.66
10	3.24	35	11.16	60	19.11	85	27.06	110	35.02	135	42.98
11	3.55	36	11.47	61	19.42	86	27.38	111	35.34	136	43.29
12	3.86	37	11.79	62	19.74	87	27.70	112	35.65	137	43.61
13	4.18	38	12.11	63	20.06	88	28.02	113	35.97	138	43.93
14	4.49	39	12.43	64	20.38	89	28.33	114	36.29	139	44.25
15	4.81	40	12.74	65	20.70	90	28.65	115	36.61	140	44.57
16	5.12	41	13.06	66	21.02	91	28.97	116	36.93	141	44.88
17	5.44	42	13.38	67	21.33	92	29.29	117	37.25	142	45.20
18	5.76	43	13.70	68	21.65	93	29.61	118	37.56	143	45.52
19	6.07	44	14.02	69	21.97	94	29.93	119	37.88	144	45.84
20	6.39	45	14.33	70	22.29	95	30.24	120	38.20	145	46.16
21	6.71	46	14.65	71	22.61	96	30.56	121	38.52	146	46.48
22	7.03	47	14.97	72	22.92	97	30.88	122	38.84	147	46.79
23	7.34	48	15.29	73	23.24	98	31.20	123	39.16	148	47.11
24	7.66	49	15.61	74	23.56	99	31.52	124	39.47	149	47.43
25	7.98	50	15.93	75	23.88	100	31.84	125	39.79	150	47.75
26	8.30	51	16.24	76	24.20	101	32.15	126	40.11	151	48.07
27	8.61	52	16.56	77	24.52	102	32.47	127	40.43	152	48.39

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

DIAMETERS OF PIPE FOR LENGTHS FROM 30 TO 300 FEET, BLOWER OUTLETS VARYING FROM 3 TO 24 INCHES.

Length of pipe, feet.	30	60	90	120	150	180	210	240	270	300
Diameter of blower outlet, inches.	Diameter of pipe, inches.	Diameter of pipe, inches.	Diameter of pipe, inches.	Diameter of pipe, inches.	Diameter of pipe, inches.	Diameter of pipe, inches.	Diameter of pipe, inches.	Diameter of pipe, inches.	Diameter of pipe, inches.	Diameter of pipe, inches.
3	3¼	3⅝	4	4¼	4½	4¾	5	5⅛	5⅜	5½
3½	3¾	4⅛	4½	4⅞	5	5¼	5½	5⅝	5⅝	6⅛
4	4⅜	4¾	5⅛	5⅜	5¾	6	6¼	6½	6¾	7
4½	5	5⅜	5¾	6	6⅜	6⅜	7	7¼	7½	7⅞
5	5½	6	6⅜	6¾	7⅛	7½	7¾	8⅛	8⅜	8¾
6	6½	7	7⅝	8	8½	9	9⅜	9¾	10⅛	10½
7	7⅝	8¼	8⅞	9⅜	10	10⅜	10⅞	11⅞	11¾	12⅛
8	8¾	9½	10⅛	10¾	11⅜	11⅞	12⅜	12⅜	13⅜	13⅞
9	10	10¾	11½	12⅛	12¾	13⅜	14	14½	15⅛	15⅝
10	11	11⅞	12¾	13½	14¼	14⅞	15½	16⅛	16¾	17⅜
11	12	13	13⅞	14¾	15⅝	16⅜	17⅛	17¾	18½	19⅛
12	13⅛	14¼	15¼	16⅛	17	17⅞	18⅝	19⅜	20⅛	20⅞
13	14¼	15⅜	16½	17½	18⅜	19¼	20⅛	21	21¾	22⅝
14	15⅜	16⅝	17¾	18⅞	19¾	20¾	21¾	22⅝	23½	24¼
15	16½	17¾	19	20⅛	21¼	22¼	23¼	24¼	25⅛	26
16	17½	19	20⅜	21½	22⅝	23¾	24¾	25⅞	26⅞	27¾
17	17⅝	20⅛	21½	22¾	24	25¼	26⅜	27½	28½	29½
18	19¾	21⅜	22¾	24¼	25½	26¾	27⅞	29⅛	30⅛	31¼
19	20⅞	22½	24	25½	27	28¼	29½	30¾	31⅞	33
20	22	23⅝	25⅜	27⅞	28⅜	29¾	31	32¼	33½	34¾
21	23	24⅞	26⅝	28¼	29¾	31⅛	32½	33⅞	35¼	36⅜
22	24⅛	26⅛	27⅞	29½	31⅛	32⅝	34⅛	35½	36⅞	38⅛
23	25¼	27¼	29⅛	30⅞	32½	34⅛	35⅝	37⅛	38½	39⅞
24	26½	28½	30⅜	32¼	34	35⅝	37¼	38¾	40¼	41⅝
Length of Mouthpiece, inches	9	15	21	27	33	39	42	48	54	60

now used in the construction of the latest type of sleeping cars. While the present steel casting producing capacity may seem entirely too great for immediate needs, nevertheless, it is certain that it will prove none too large when the railroad buying movement again sets in.

PERSONAL.

L. A. Crandall, who has had a wide experience in the foundry supply and equipment trade, has recently accepted a position with the J. W. Paxson Co., Philadelphia, and will be placed in charge of the territory west of Pittsburg and Buffalo, where a warehouse will be established. During the past 22 years Mr. Crandall has called on the foundry trade throughout the United States, although for eight months during this period he occupied a responsible position in a steel foundry to more closely acquaint himself with the requirements of this growing industry. Eleven years ago he designed the Crandall or bosh cupola, and has sold a number of furnaces of this type, while this bosh attachment has been placed on a number of other makes of cupolas. Mr. Crandall served his apprenticeship as a machinery molder and held many positions of responsibility in a number of large foundries.

William Pertell, until recently president and general manager of the Worcester Steel Foundry Co., Worcester, Mass., has entered the sales department of the Allis-Chalmers Co., with headquarters in Boston.

Geo. H. Seltzer, assistant sales manager of Stanley G. Flagg & Co., Philadelphia, has recently associated himself with the Thos. Devlin Mfg. Co., of the same place, manufacturer of pipe fittings and hardware specialties.

Wm. H. Sickels, formerly superintendent of the foundry operated by the Bernstein Mfg. Co., Philadelphia, now has charge of the Clark Bros. foundry, Belmont, N. Y.

Arthur Simonson has sold his interest in the Tropenas Steel Casting Co., New Castle, Del., and has severed his connection with that concern. His personal address is 5618 Girard Ave., Philadelphia.

E. E. Brosius, Alliance, O., has been appointed sales engineer of Pawling & Harnischfeger, Milwaukee, manufacturers of traveling cranes.

BRITISH FOUNDRYMEN'S ASSOCIATION.

The annual convention of the British Foundrymen's Association is to take place in August next in Birmingham, and will be on the customary lines. The choice of rendezvous is partly due to the fact that the president is a Birmingham man. F. J. Cook is foundry manager to Bellis & Morcom, a firm of world-wide reputation. Birmingham is a great engineering center and the opportunity will be taken to visit some large works in the district. The morning sessions will be devoted to the reading of papers, the afternoons being spent in visits to foundries, etc. The organization continues to progress, a large number of members having been added since the meeting in Newcastle-on-Tyne, in August last.

BOOK REVIEWS.

Foundry Work. By Wm. C. Stimpson, American School of Correspondence. Chicago. Cloth, 143 pages, price $1. This work is especially adapted for purposes of self-instruction and home study, and the utmost care has been exercised to bring the treatment of each subject within the range of common understanding, so that the work should appeal not only to the technically trained expert but also to the beginner and the self-taught practical man who wishes to keep abreast of modern practice. The language is simple and clear, and heavy technical terms have been avoided without sacrificing any of the requirements of practical instruction. The arrangement of matter is such as to carry the reader along by easy steps to a complete mastery of each subject. Frequent examples for practice are given to enable the reader to test his knowledge and the illustrations are selected with care to supplement and make clear the references in the text. The underlying principles involved in making molds for gray iron castings are clearly presented, together with the mixing and melting of metals for such castings. The chapters on brass founding and steel casting emphasize only those features of the methods used which are different from iron foundry practice. The chapter on shop management is intended to set students thinking on this subject, because the whole trend of modern shop practice is toward specialization in order to increase efficiency and reduce cost.

Morrison's Spring Tables and Handbook for Engineers, Students and Draftsmen. By Egbert R. Morrison, Jun. Am. Soc. M. E. Sharon, Pa. Morrison & Martin. 84 pages, 6 x 9 inches. Cloth. Supplied by THE FOUNDRY for $2.

The purpose of this little book is to facilitate calculations in designing helical and elliptical steel springs. It begins with seven pages of formulae, for all questions that may enter into the calculations, such as length and diameter of bar, diameter of coil, weight of spring and capacity at various heights. It is stated that the working static stress is taken at 80,000, the modulus of elasticity at 25,400,000 and the modulus of torsional elasticity at 12,600,000. The method of deriving the formulae is not given, but this is no doubt available in standard works on machine design. The rest of the book is entirely devoted to spring tables. Values of length, weight and free height per inch of solid height and of capacity are given for every diameter of helical bar from 1/16 inch up to 1½ inches, varying by sixteenths, and for all these diameters of bar for various outside diameters of coil, varying by 1/16 inch for all sizes for which the bar is adapted. Tables are also given for the rectangular and elliptical sections and for elliptical plate springs, covering the whole range of practical dimensions. Such questions as what is the capacity and what the length, weight and free height per inch of solid height of a spring whose outside diameter is 1 inch, inside diameter ½ inch and diameter of bar ¼ inch, are answered immediately by reference to these tables without calculations of any kind.

The book will no doubt be found of great value by all designers who have occasion frequently to make designs of springs.

EASTERN WAREHOUSE.

The Millers Products Co., Chicago, manufacturer of the "Black Diamond" core compound and foundry flour, has established a warehouse in Philadelphia from which quick shipments will be made to its eastern trade. S. H. Baird, formerly general western agent of the H. E. Mills Manufacturing Co., Syracuse, N. Y., has been appointed eastern manager for the Chicago firm, with headquarters at 639-40 Real Estate Trust building, Philadelphia. A large enough stock of core compound and foundry flour will always be maintained in Philadelphia to promptly fill orders of any size.

The Cutler-Hammer Mfg. Co., Milwaukee, manufacturer of electric controlling devices, has established an office at 1108 Schofield building, Cleveland, in charge of C. J. Kruse, formerly connected with the engineering department of this concern.

FOUNDRY & PATTERN SHOP EQUIPMENT

Combined Hand Squeezer and Pattern Drawing Molding Machine---Mold Drying Apparatus---Stove Polishing Outfit --- Steel Foundry Flask --- Steel Spout Bellows

A COMBINED squeezer and pattern drawing molding machine adapted for a wide range of work, is shown in the accompanying illustrations. When match plates are used with half patterns on opposite sides of the plate, a complete mold is made with every operation, both cope and drag being rammed at the same time. In addition, split patterns mounted on boards, sand matches and pattern plates with half patterns on one side only, can be mounted on the machine without special preparation.

The machine consists of a cast iron table to the frame of which is attached the pattern drawing mechanism. The tilting, ramming head is attached to a cast iron cross bar supported on two steel uprights, operating on shafts fastened to the frame. The table is slotted to permit of the passage of the pattern and flask lifting posts, and slots are also provided for the adjustment of the flask stops, which can be set for any flask within the capacity of the machine. These stops serve as guides for the operator and after being set to the size of the flask, locate the same on the table in its proper position underneath the ramming head. Slots are also provided for bolting pattern plates to the table. A vibrator, knee operated, is also attached to the machine.

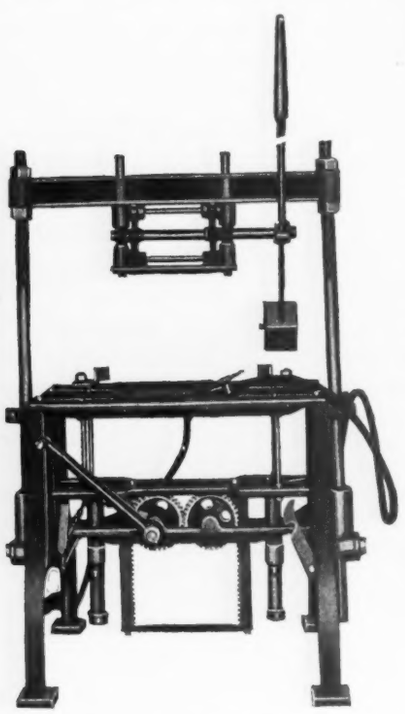


FIG. 1—COMBINED HAND SQUEEZER AND PATTERN-DRAWING MOLDING MACHINE WITHOUT FLASK ON THE TABLE. THE RAMMING HEAD IS IN NORMAL POSITION

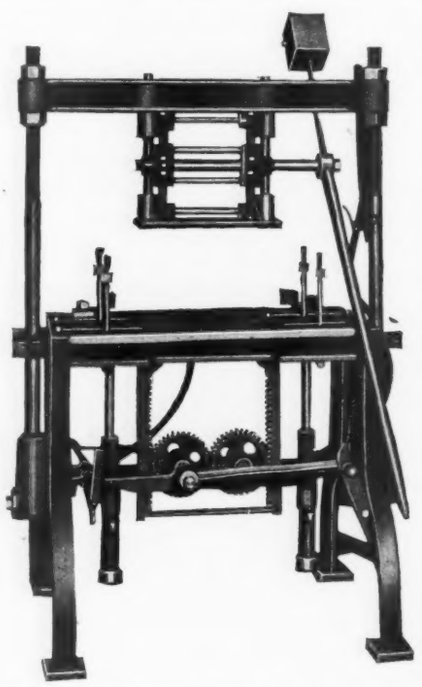


FIG. 2—RAMMING HEAD LOWERED AND PATTERN AND FLASK LIFTING POSTS RAISED

The ramming head is unique in construction and the compound toggle movement utilized reduces the power required to ram a mold to the minimum. The greatest power is exerted at the point where the hardest pressure is required, and as the toggles are self-releasing, it is impossible to ram a mold harder than the density desired after the head has been adjusted for the pattern to be molded.

The head is adjustable up and down, this being controlled by nuts on the two steel uprights. The squeezing lever is of sufficient length to be operated without great exertion and is counterbalanced at one end with an adjustable weight. All operating parts of the head, including the toggle shafts and toggles, as well as the lever, are made of manganese bronze, and wear on the operating parts is thereby reduced to the minimum. The tilting of the head is controlled by springs attached to the lower ends of the steel uprights and the frame of the machine.

In Fig. 1 the head is shown raised, in the position it assumes before ramming, and in Fig. 2 the head has been lowered and the pattern and flask-lifting posts have been raised to the position they assume when the pattern is being drawn and the cope flask is being lifted away from the pattern. This mechanism is controlled by the lever shown at the

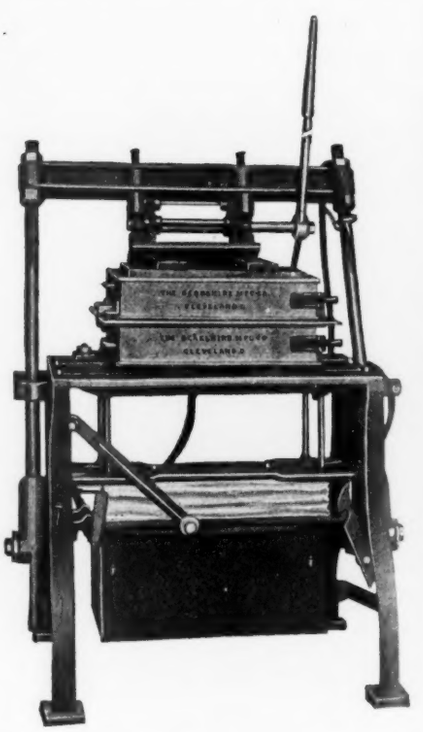


FIG. 3—FLASK FILLED WITH SAND WITH MATCH PLATE BETWEEN COPE AND DRAG. THE RAMMING HEAD IS TILTED BACK. THIS VIEW SHOWS THE SHEET STEEL AND CANVAS CASE WHICH ENCLOSES THE OPERATING PARTS

side, which is thrown over by the operator while he is vibrating the pattern, by pressing his knee against the lever controlling the vibrator. The post-raising lever is held until released by a spring latch. The four posts are attached to a slotted cast iron frame, which permits of their adjustment to pattern plates, match plates and flasks of various sizes. The frame to which the posts are attached is operated by gears running in side racks, insuring an absolutely straight lift at all times, and as an additional precaution this frame is supported by guide posts at either end, operating in long bearings provided with oil reservoirs, which can be filled without removing the sheet steel case shown in Figs. 3 and 6. All of the operating parts beneath the table are entirely enclosed by a canvas case between the center frame and the table, and a sheet steel case is located underneath the middle frame, entirely enclosing the oil reservoirs and the bearings of the guides of the center frame. For cleaning the patterns, a blow-off is also provided.

The various operations necessary for making a complete mold with one

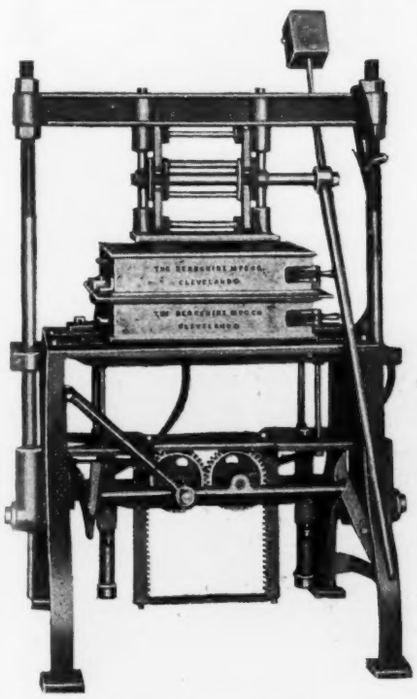


Fig. 4—Ramming Head Tilted Forward and Mold Rammed by Downward Stroke of the Squeezing Lever

stroke of the squeezing lever are consecutively shown in Figs. 3, 4 and 5. In Fig. 3 the match plate with patterns on opposite sides is shown between the cope and drag halves of a snap flask, which has been filled with sand, the bottom and cope boards being in position. The head is shown tilted back so as not to interfere with the operator. In

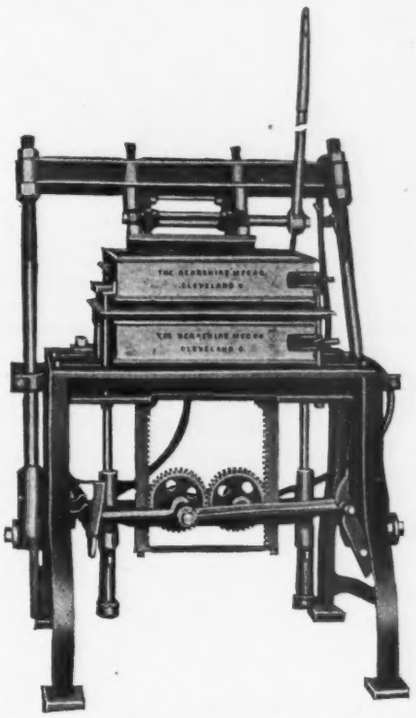


Fig. 5—Pattern-Drawing and Flask-Lifting Posts Raised, Withdrawing Match Plate from Cope and Drag Halves of the Mold

Fig. 4 the head has been tilted forward in a vertical position over the flask, and the mold has been rammed by the downward stroke of the squeezing lever, which actuates the ramming head. In Fig. 5 the pattern and flask-lifting lever has been swung over, thereby raising the four posts, and the match plate has been lifted from the drag mold by the lugs on the posts while the ends of the latter in contact with the lugs on the cope half of the snap flask, have lifted the same away from the upper side of the match plate. The cope is then lifted off, the match plate is removed and the drag on the bottom board is set on the floor. The mold is then closed and the flask removed.

The use of a pattern plate with split patterns on one side is illustrated in Fig. 6. The plate is bolted to the table, the flask set in position, filled with sand and with the bottom board in place is rammed as previously described. After tilting back the head the mold is lifted away from the patterns by the four posts as shown.

The use of a sand match with movable patterns is shown in Figs. 7 and 8. The match plate is placed on the table, the flask is set on the same and the mold is rammed. After tilting back the head, the mold, together with the sand match is rolled over, assuming the position shown in Fig. 7, and the match board is lifted away from the drag by the four lifting posts which engage lugs on the ends of the frame of the match board. The patterns are left in the sand, the cope flasks adjusted, filled with sand and rammed. The cope flask is then lifted away from the patterns, as shown in Fig. 8, and after they have been withdrawn from the sand the mold is closed.

Any size pattern plates up to and including 16 x 24 inches, can be mounted on the machine, which is also adapted for deep lifts, having a draft up to eight inches. The machine is built in three sizes by the Berkshire Mfg. Co., Cleveland.

The Rockwell Furnace Co., 26 Cortlandt street, New York City, has pur-

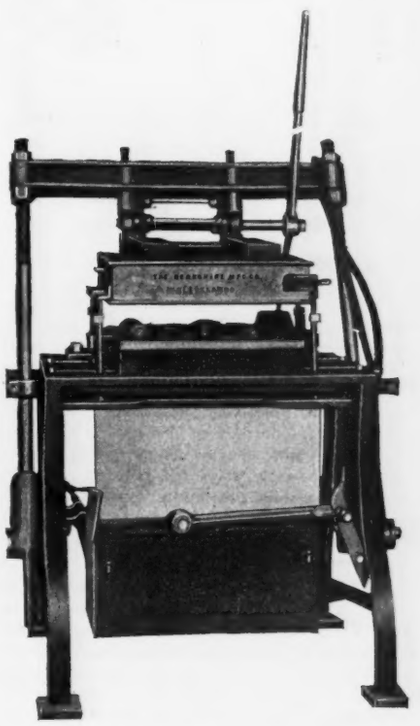


Fig. 6—This View Illustrates the Use of a Pattern Plate with Split Patterns on One Side. The Sheet Steel and Canvas Case is Also Shown in Position

chased the factory, drawings, patterns, etc., of the Rockwell Engineering Co., and the business will hereafter be transacted under the firm name of the Rockwell Furnace Co.

TRADE PUBLICATIONS.

REFRACTORIES.—The Harbison-Walker Refractories Co., Pittsburg, has issued a handsome leather bound catalog, which contains much useful information for the foundryman, steel manufacturer and blast furnace operator, in connection with the use of silica, magnesia, chrome and fire clay brick and various refractories. The methods of lining the various types of hot blast stoves, blast furnaces, coke ovens, malleable, open-hearth, air and gas furnaces, as well as cupolas, is clearly illustrated with sectional views. The work also contains many valuable tables and is well illustrated.

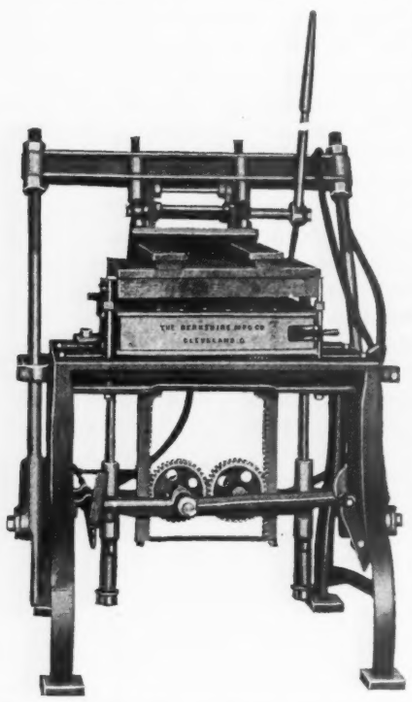


FIG. 7—SAND MATCH USED FOR MAKING MOLD. IT IS SHOWN RAISED OFF THE DRAG BY THE FOUR LIFTING POSTS

PUMPS.—The Blake & Knowles Steam Pump Works, New York City, has issued four bulletins which are devoted to descriptions of vertical, single and double acting duplex power pumps, deep well pumps for artesian and curb wells and power and steam driven ammonia pumps. The bulletins are all well illustrated and contain much valuable information for the power engineer.

AIR COMPRESSORS.—The American Compressor & Pump Co., 26 Cortlandt street, New York City, in bulletin A, illustrates and describes duplex steam-actuated two-stage air compressors, single steam driven compressors of solid box bed pattern, belt driven two-stage air compressors, duplex belt air compressors, as well as vertical air compressors. This concern also manufactures air receivers, as well as high duty vacuum pumps.

GRINDING WHEELS AND MACHINERY.—The Norton Company, Worcester, Mass., has issued a 167-page catalog, handsomely illustrated, devoted to grinding wheels and grinding machinery. The products described include the abrasive, alundum, grinding wheels and machinery, glass cutting wheels, India oil stones, razor hones, scythe stones, rubbing and sharpening stones, etc. Halftone illustrations of the company's plant at Niagara Falls where alundum is produced, and which is used as the abrasive in the manufacture of the grinding wheels made by this concern are given. The method of producing the same is also described and views of the various departments are shown. Considerable space is also devoted to grinding machines adapted for practically all classes of work. The catalog also contains many valuable tables, as well as cross sections of all of the various wheels made.

BLOWERS AND EXHAUSTERS.—The American Blower Co., Detroit, has published a small, 24-page handbook describing blowers and exhausters for forges and furnaces, which contains many valuable tables relating to blowers for forges, heating and melting furnaces, etc. The booklet is well illustrated and should prove of value to every engineer.

CENTRIFUGAL PUMPS.—The D'Olier Engineering Co., Philadelphia, has issued a handsomely illustrated 46-page catalog describing its line of horizontal centrifugal pumps. It contains numerous illustrations of large installations, which also show the adaptibility of these machines for various classes of work.

DRYING MOLDS WITH THE OIL BURNER.

Where the oil burner is employed in baking molds, it is frequently found inadvisable for one reason or another to apply the flame direct, and to overcome this difficulty a drying box has been devised by the Hauck Mfg. Co., Brooklyn and New York City, for use in connection with its portable burners. As made clear in the accompanying illustration, this is simply a sheet iron box fitted with handles for convenience in moving about the foundry; it is lined with asbestos sheeting and contains an opening at one end through which the flame enters from a burner fixed in a frame riveted to the box. This box is placed over the mold, to which a clean uniform heat is reflected, the arrangement being such that it can be reflected downwards from 6 inches to 4 feet. In this way there is not only no ash deposited over the mold, as is the case with the use of charcoal or sprinklers, but the waste heat is absolutely eliminated. This burner produces a soft, regular flame, well suited for sweeping over the mold in skin-drying work. It can be concentrated to such an extent that operation is possible well down into the drag without burning corners and edges, thus reducing the loss in this process to an extremely low percentage.

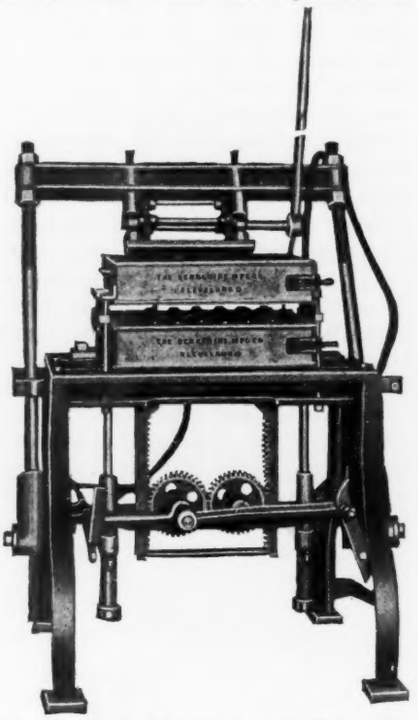
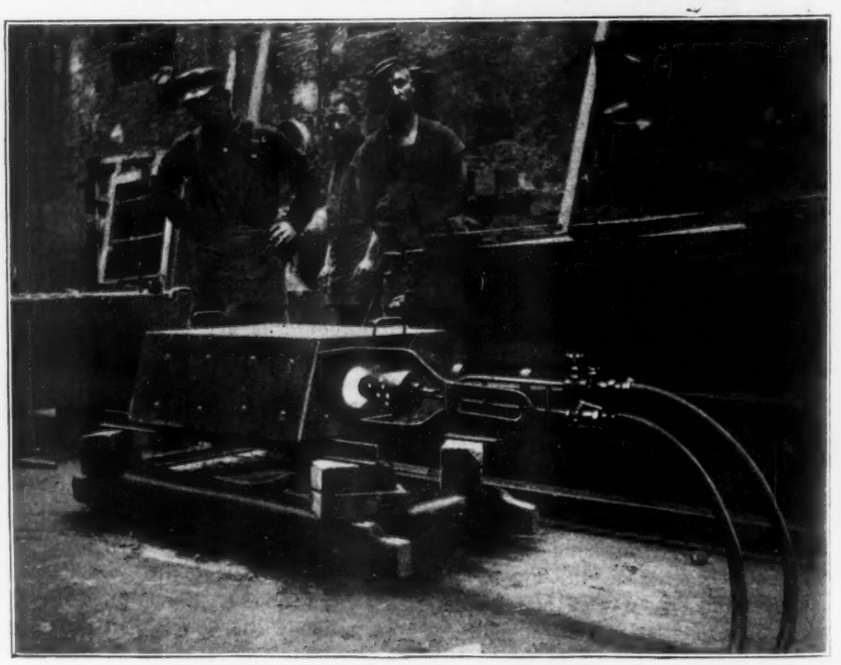


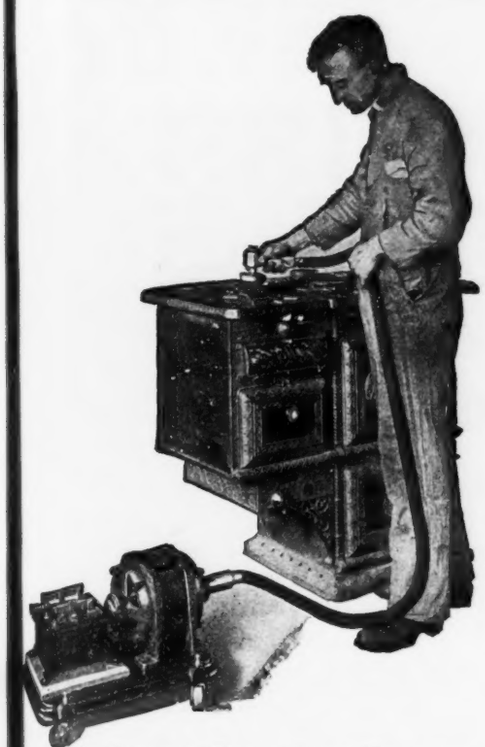
FIG. 8—SAND MATCH LIFTED OFF, COPE FLASK RAMMED AND RAISED FROM CARD OF PATTERNS BY THE FOUR LIFTING POSTS



HAUCK BURNER ATTACHED TO SHEET IRON BOX USED FOR DRYING MOLDS

A FLEXIBLE SHAFT POLISHER.

The stove polishing outfit shown in the accompanying illustration consists of a General Electric, ½-horsepower motor mounted on a small portable truck fitted with swivel rollers, and an 8-foot Coates, unit link flexible shaft, securely fastened to the armature shaft of the motor. The flexible shaft revolves inside of a steel wire coil which in turn is covered with leather, making the total thickness of the shaft about 1 13/16 inches. An angle head fitted to the end of the flexible shaft, carrying a suitable

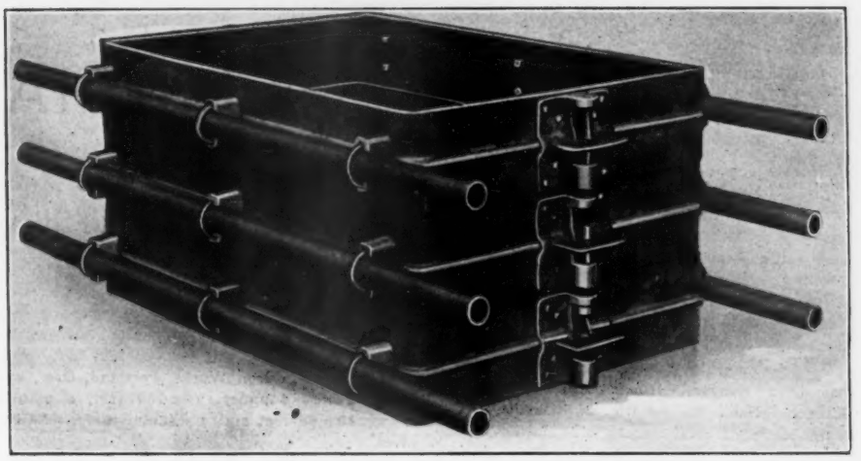


A FLEXIBLE SHAFT STOVE POLISHING OUTFIT

bristle brush completes the outfit. It is adapted for polishing stoves, being easily carried to the stove to be cleaned, thus eliminating troublesome trucking to the polishing department before shipment. The polishing brush can be easily removed and a screw driver or emery wheel attached, with which screws can be set or burrs removed without moving the stove. The entire outfit is manufactured by the Coates Clipper Mfg. Co., Worcester, Mass..

STEEL FLASK FOR FLOOR WORK.

Three sections of a steel flask for floor work made by the Sterling Wheelbarrow Co., Milwaukee, are shown in the accompanying illustration. The flask is made of one strip of steel, bent to shape, the ends being fastened together by one of the two malleable iron pin holders, to which they are riveted. The steel strip is beaded on one side which greatly increases the strength of the flask and it is provided with flanges on both edges to aid in supporting the sand. The pins are so designed that a two or three-part flask can be made from a corresponding number of sections, and these can also be built up as desired for a two or three-part flask. These changes are effected in some cases without changing pins, but occasionally pins of different lengths must be used. Pipe handles are fastened to the sides of the flask directly over the bead by U-bolts. These flasks are made in three sizes up to 20 x 42 inches and in depths of 4 or 5 inches.



STEEL FLASKS MADE FROM SPECIAL, ROLLED SECTIONS

TRADE NOTES.

The Specialty Foundry Co., Zelienople, Pa., has installed two Northern traveling cranes of one and five tons capacity each.

The Berkshire Mfg. Co., Cleveland, has received nine repeat orders for the Berkshire automatic molding machine during the last 30 days. The concerns to whom these orders were shipped all operate one or more automatic molding machine.

C. W. Leavitt & Co., importers and selling agents of ores, metals and alloys, New York City, have been appointed American selling agents for the Societe Maritime & Commerciale, Antwerp, Belgium, manufacturers of iron and copper pyrites, copper precipitate, copper matte, manganese ore and other products.

"Aid to Shippers" is the title of a 72-page booklet which contains considerable information of value to manufacturers engaged in the export and import trade. It has been issued by Oelrichs & Co., New York, for more than 40 years the American representatives of the North German Lloyd Steamship Co. The table of foreign moneys with United States equivalents, together with weights, measures, tariffs, customs requirements, etc., will be found of great value. The book will be sent postpaid on request by addressing the forwarding department of Oelrichs & Co., 5 Greenwich St., New York City.

STEEL SPOUT FOUNDRY BELLOWS

STEEL SPOUT FOUNDRY BELLOWS.

The S. Obermayer Co., Cincinnati, is offering to the foundry trade a blue leather, steel spout bellows, shown in the accompanying illustration. It is provided with a sheet steel spout and at the weakest point of the bellows three thicknesses of leather, oil soaked, are placed to prevent wear. The steel spout is so constructed that it cannot be easily bent and it is thoroughly coated to prevent rusting. The blue leather is prepared by a special process to prevent cracking.

GENERAL INDUSTRIAL NOTES

The new plant of the Meech Foundry Co., located on Meech avenue, Cleveland, was placed in operation March 22. This company's foundry was destroyed by fire in December, and the new plant consists of a foundry 50 x 75 feet, machine shop and cleaning room 30 x 40 feet, core shop 18 x 30 feet, and a carpenter shop 18 x 20 feet. This concern makes a specialty of light gray iron castings.

The plant of the Howard Stove & Mfg. Co. has been removed from Savannah, Mo., to Ralston, Neb., a suburb of Omaha. The main offices of this concern are located at 320 to 321 Ranger building, Omaha. This concern manufactures gray iron castings for stove work.

The Carbondale Machine Co., Carbondale, Pa., recently placed its new iron foundry in operation. The plant is 50 x 150 feet and is commanded by a ten-ton Harrington crane, provided with electric hoist. The shop was built under the supervision of L. C. Dodd, formerly with the Snow plant of the International Steam Pump Co., Buffalo. The iron will be melted in a Whiting cupola.

The firm of Butler & Miller has been organized at Torrion, Coah, Mexico, by R. H. Miller, during the past three years foreman of the foundry department of the Torreon Iron Foundry, and H. H. Miller, formerly of Palestine, Texas, who has had a wide business experience in Mexico. A brass foundry will be operated for the production of brass, copper and aluminum castings.

New Construction.

The Billings Foundry & Mfg. Co. has been organized at Billings, Mont., with J. C. O'Donnell as manager. This concern will engage in the foundry business and will operate a plant for the production of gray iron and small steel castings. Two buildings 40 x 100 feet, and one building, 40 x 150 feet, two stories high, will be built.

The Chester Gray Iron Foundry Co., Chester, Pa., will erect a foundry, 40 x 60 feet, having wing extensions, 54 x 60 feet.

The Enid Foundry Co, Enid, Okla., has begun the erection of an addition to its plant, 50 x 100 feet.

The Plant City Foundry & Machine Co., Plant City, Fla., has broken ground for a new plant which will cost approximately $5000. The plant will contain in addition to a machine shop, a foundry for the production of gray iron and brass castings.

Plans for the new plant which will be erected at Rochester, N. Y., by the T. H. Symington Co., Baltimore, Md., have been completed and include a foundry 422 x 456 feet, machine shop 48 x 120 feet and a two-story office building 44 x 66 feet. The foundry will be equipped for the production of malleable iron journal boxes for freight and passenger cars, center plates and miscellaneous railroad malleables.

The Oklahoma Iron Works, Tulsa, Okla., has purchased a site of 12 acres upon which a new foundry will be erected. Daniel J. Morgan, engineer in charge, has not as yet completed plans for the new buildings.

The Cascaden Mfg. Co., Waterloo, Iowa, will rebuild part of its plant recently destroyed by fire, and it is probable that a new cupola as well as an electric motor and hoist will be installed.

The Crane Co., Chicago, manufacturer of valves, pipe fittings, etc., will erect a new manufacturing plant at Canal and 15th streets, 190 x 241 feet and six stories high. The foundry will be located on the top floor.

The Foundry of the Luzerne Mfg. Co., Luzerne, Pa., destroyed by fire several months ago, will shortly be rebuilt. The main building will be 40 x 220 feet, one section of which will be used as a foundry and the remainder as a machine shop.

The E. J. Gardner Axle & Machine Co., Carlisle, Pa., will rebuild the foundry, machine shop and pattern department recently destroyed by fire. The foundry will be 40 x 180 feet.

The Phoenix Iron Works, Portland, Ore., will erect a new foundry, 80 x 150 feet, a pattern shop, 30 x 60 feet and a machine shop, 80 x 150 feet.

The Stier Brass Foundry Co., Dayton, Ohio, has been organized to engage in the manufacture of brass, copper and aluminum castings. The new plant at Keowee and Herbert streets was recently placed in operation. Herman A. Stier, formerly with the Miami Brass Foundry Co., is general manager.

The John Inglis Co., Toronto, is considering the erection of a foundry for large floor work and is now negotiating for a site in the vicinity of its present plant. The new shop will be about 100 x 200 feet and will be well equipped throughout.

The Waterloo Gas Engine Co., Waterloo, Ia., is erecting an addition to its foundry 80 x 220 feet. This will increase the total foundry floor space to 80 x 300 feet. This concern recently increased its capital stock from $66,000 to $200,000.

The Plattsburg Foundry & Machine Co., Plattsburg, N. Y., will erect a foundry, pattern shop and pattern storage building. The foundry addition will be one story high, 30 x 80 feet, the pattern storage building will be two stories high and the pattern shop will be erected as an addition on the north side of the machine shop.

The Vulcan Iron Works, Seattle, Wash., has purchased a new site for its plant, having a frontage of 540 feet on Fourth avenue and 270 feet on Connecticut street. The property is now being filled to datum and as soon as the filling is completed operations will be commenced on the erection of the new plant. It will consist of the following buildings: foundry, 106 x 150 feet; supply and jobbing house, 100 x 270 feet, seven stories high of brick, steel and concrete construction; machine shop 90 x 150 feet; forge shop, 60 x 150 feet; pipe and threading shop, 60 x 60 feet; pattern shop and loft, 60 x 100 feet; structural shops, 76 x 150 feet. The entire plant will be electrically driven and many pneumatic tools will be installed. Sidings from four transcontinental lines will be laid into the plant. This concern will be pleased to receive catalogs from manufacturers of foundry equipment, machine tools, forges, as well as data relating to reinforced concrete construction.

The Bettendorf Axle Co., Davenport, Iowa, will install two 25-ton basic open-hearth furnaces in the new steel foundry which is now being erected.

The Reading Iron Co., Reading, Pa., will erect a new pipe shop, 273 x 400 feet.

Love Bros., Aurora, Ill., will erect a large addition to their foundry, 60 x 247 feet.

The Frontier Iron Works, Buffalo, will erect a foundry, machine and pattern shops at Letchworth and Grand streets.

The Spokane Ornamental Iron & Wire Works, Spokane, Wash., will increase its capital from $25,000 to $100,000 to provide for the cost of erecting a new plant which will be built this year. Among other departments it will include a foundry for the manufacture of ornamental iron and bronze castings.

The Huntsville Foundry & Machine Works, Huntsville, Ala., will erect a new foundry, 75 x 120 feet. Practically all of the equipment has already been purchased.

The Pitts Foundry & Contracting Co. is erecting a new foundry at South Houston, Texas, which will make a specialty of fine gray iron castings. The main building will be 80 x 125 feet and separate structures will be built for the pattern shop, cleaning department and core room. One 15-ton traveling crane will be installed as well as five 2-ton trolleys.

The Seneca Pattern & Supply Co., Seneca Falls, N. Y., whose plant was recently destroyed by fire, has made arrangements for a factory building at Geneva, N. Y., which was formerly occupied by the Hayes Track Appliance Co.

The Deemer Steel Casting Co., New Castle, Del., will install two Paxson-Deemer side-blow converters, two Paxson-Colliau cupolas, one 63-inch and one 35-inch, and six Niles electric cranes from two to 10 tons capacity each. This concern will make a specialty of railroad switches, steel car wheels with soft centers and other railroad work.

The Waterloo (Iowa) Gasoline Engine Co., has increased its capital stock from $100,000 to $200,000, and will erect an addition to its foundry.

The General Electric Co., Schenectady, N. Y., will shortly begin the erection of an addition to its new foundry at Pittsfield, Mass., which will be 75 x 300 feet. An extension to the main building will also be built, 205 feet long, which will be used for storage purposes.

The Mount Holley Iron Works, Mount Holley, N. J., will erect a new foundry for the production of brass castings and plumbers' supplies. Grover C. Johnson is secretary and treasurer.

The Federal Brass Foundry Co., South Bend, Ind., has been organized with Chas. L. Kenney of Elkhart, Ind., president and treasurer, and George Rush has been appointed superintendent. A building has been secured at 319-321 Hydraulic avenue, which will immediately be fitted up as a brass foundry.

The Lebanon Steel Casting Co., Lebanon, Pa., has recently completed extensive improvements, including an office building and cleaning room. This concern makes a specialty of small automobile castings.

The Clinton Foundry Co., Clinton, Mass., has been incorporated with $33,000 capital, and will operate a foundry and a machine shop. The officers of this concern are Walter A. Stone, president; George C. Stone, treasurer, and Gordon A. Brown, secretary.

The new plant of the Allegheny Valley Malleable Iron Co., New Kensington, Pa., completed about a year ago, has recently been placed in operation. The general offices have been located in the Frick Building Annex, Pittsburg.

The plant of the Vulcan Foundry & Machine Co., New Castle, Pa., has been purchased by Wickes Bros., Pittsburg, and is being dismantled. It comprises a machine shop, foundry, pattern shop and power plant, and represents an investment of about $150,000.

The Modern Foundry & Machine Co., Paris, Ill., has been incorporated with a capital stock of $100,000. This concern succeeds the Paris Foundry & Machine Works of that place and the Modern Concrete Machine Co., Terre Haute, Ind. The plant at Paris, including the foundry, will be enlarged.